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GRASSES

AND

FORAGE PLANTS

A PRACTICAL TREATISE

COMPRISING

THEIR NATURAL HISTORY; COMPARATIVE NUTRITIVE VALUE; METHODS OF CULTIVATING, CUTTING, AND CURING; AND THE MANAGEMENT OF GRASS LANDS IN THE UNITED STATES AND BRITISH PROVINCES

BY

CHARLES L. FLINT

LATE SECRETARY OF MASSACHUSETTS STATE BOARD OF AGRICULTURE; MEMBER OF BOSTON SOCIETY OF NATURAL HISTORY; AUTHOR OF "MILCH COWS AND DAIRY FARMING," ETC., ETC

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PREFACE.

The object of the following pages is to embody the most recent practical and scientific information on the history, culture, and nutritive value, of the grasses and the grains. To make the work practically useful, I have treated the subject with plainness and simplicity, so far as it admits of it, and have at least indicated to the reader the vast field of study which lies open before him in this direction.

The large number of illustrations of the different species of grasses, drawn, as they have been, with great care and accuracy, will serve to facilitate the study and identification of unknown specimens. Most of these appeared in the first and second editions of the work. I have added to this edition a few, drawn by Professor I. A. Lapham, of Milwaukie.

In treating the subject from an economical point of view, I have tried to give what is known to be of special value, and have presented the experience of practical men upon points about which the opinions of farmers differ. The reader will be best able to judge how far I have succeeded in accomplishing my object.

It seems unnecessary to dwell here upon the importance of the subject. Perennial grasses, says an eminent practical farmer, are the true basis of agriculture in the highest condition of that best employment of man. Grasses which are not perennial are of immense value, especially as one of the shifts in the ordinary rotation of crops, suited to the agriculture of the great upper or northerly portion of our continent, all of it above the cotton line. But it is the grasses which are perpetual to which we are to look for our chief success in farming.

Perhaps the most forcible expression of opinion on this point may be found in a French writer, who asserts that the term grass is only another name for beef, mutton, bread, and clothing; or in the Belgian proverb, "No grass, no cattle; no cattle, no manure; no manure, no crops!"

If my researches, imperfect as they doubtless have been, should have the effect of creating a more general interest in the subject, and leading to more careful inquiry, and more general and accurate investigation, I shall be amply rewarded for any labor which I have bestowed upon the preparation of the following pages.

C. L. F.

BOSTON, *May*, 1887.

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GRASSES AND FORAGE PLANTS.

INTRODUCTION.

I PROPOSE to speak of the grasses, a family of plants the most extensive and the most beautiful, as well as the most important to mankind. It embraces nearly a sixth part of the whole vegetable kingdom; it clothes the globe with perpetual verdure, or adorns it at fixed seasons with a thick matted carpet of green, none the less beautiful for its simplicity; and it nourishes and sustains by far the greater part of the animals that serve us and minister to our wants.

When we consider the character of our climate, and the necessity that exists, throughout all the northern and middle portions of the United States and the Canadas, of stall-feeding from three to five or six months of the year, for means of which we are dependent mainly on the grasses, it is plain that, in an economical point of view, this subject is one of the most important that can occupy the farmer's attention.

The annual value of the grass crop to the country, for pasturage and hay together, cannot be less than three hundred million dollars, to say nothing of a vast amount of roots and other plants cultivated and used as forage crops.

I shall endeavor to give a brief account of the natural history or description of all the useful grasses found in

our fields and pastures, partly because it is essential to a complete understanding of the subject, and partly because there is at present no popular treatise on the subject within the easy reach of our farmers, and something of the kind is needed for reference; but I shall confine myself mainly to a plain and practical treatment of the subject, making such suggestions as I think may be useful, on the cultivation, cutting, and curing, of the grasses for hay, the comparative value of the different varieties, and the general management of grass lands.

This subject has long been familiar to me, and has especially occupied my attention for the last few years, during which I have made an extensive collection, embracing a large proportion of the varieties described in the following pages, for preservation in the Agricultural Museum connected with my office. In addition to my own extensive observations on the subject, I have sought information in the statements of intelligent farmers in different parts of the country. Many of these I have myself conversed with, while others have favored me, in writing, with the results of their own experience, from which I shall draw with a liberal hand, for the purpose of giving the work a practical character, and of bringing the subject home to the general reader. In treating of the natural grasses, I shall limit myself mainly to a description of those species which it may be for the interest of the farmer to cultivate, or at least to encourage in his pastures, with such others as should be known, to be avoided.

In the arrangement of species I shall follow mainly the natural order adopted by Professor Gray, to whom, as well as to many others, I am indebted for no small assistance, in studying the specific characteristics of many of the specimens collected and presented in the following pages.

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CHAPTER I.

NATURAL HISTORY OF THE TRUE GRASSES WHICH ARE USED FOR FORAGE.

The grasses, in popular language, are variously divided. They are sometimes designated as natural and artificial: the former comprising all the true grasses; that is, plants with long, simple, narrow leaves, each leaf having many fine veins or lines running parallel with a central prominent vein or midrib, and a long sheath, Fig. 1, divided to the base, which seems to clasp the stem, or through which the stem seems to pass, the stem being hollow, with very few exceptions, and closed at the nodes or joints; and the latter — the artificial — comprising those plants, mostly leguminous, which have been cultivated and used like the grasses, though they do not properly belong to that family; such as the clovers, sainfoin, and medic. In common language the term is often used in a sense not strictly proper, being not unfrequently applied to any herbage which affords nourishment to herbivorous or graminivorous animals, including, of course, not only many leguminous plants, like clovers, but some others which would more properly be called forage plants.

But in botanical language, and speaking more precisely, the grasses, *Gramineæ*, embrace most of the grains cultivated and used by man, as wheat, rye, Indian corn, barley, and rice; all of which will be at once recog-

nized as having leaves and stems very similar in shape and structure to most of the plants popularly called grasses.

As the general appearance of plants is often greatly modified by climate, soil, and modes of cultivation, it is important to fix upon certain characteristics which are permanent and unaltered by circumstances, by means of which the particular genus and species may be identified with ease and certainty. It is evident that these characteristics could not be simply in the leaves, or the stems, or the size of the plant, because there will be a great difference between plants growing in a poor, thin, sandy soil, and others of the same species on a deep, rich loam.

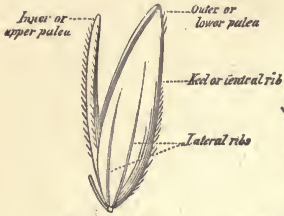
Botanists have, therefore, been compelled to resort to other parts and peculiarities, such as flowers, &c., to distinguish between different species; and the terms used to express these, like the terms used in other departments of natural history, are technical; and hence, in detailing the natural history of the grasses, the use of technical language, to a greater or less extent, cannot be avoided. I shall endeavor, however, by the use of plates and synonyms, to bring the description of species within the easy comprehension of every one who will carefully examine the subject.

The flowers of the grasses are in some cases arranged on the stem in spikes, as where they are set on a common stalk without small stalks or branches for each separate flower, as in Timothy *(Phleum pratense);* in other cases in panicles, or loose subdivided clusters, as in orchard grass (*Dactylis glomerata*). A panicle is said to be loose or spreading, as in redtop (*Agrostis vulgaris*), where the small branches on which the flowers are set are open, or extended out freely in different directions; it is said to be dense, or crowded, or

compressed, when the branches are so short as to give it more or less of the spike form.

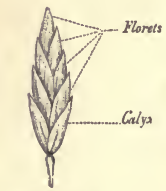
This whole arrangement will be seen in Fig. 1, which represents a stalk of the common annual spear grass (*Poa annua*), a plant familiar to every one as often troublesome in gravel walks and on hard, dry soils. Here the joint, the stem, or culm, clasped by the sheath of the leaf, the leaf itself, the ligule, and the spikelets, all distinctly appear; and the reader will do well to make himself familiar with the few technical terms used, by a study of this figure, in connection with Fig. 2, where the spikelet is so magnified as to show the florets and the calyx very distinctly, all of which are generally very easily seen with the naked eye, and Fig. 3, showing a floret still more magnified, with its two paleæ, the outer pale being the longer and generally keeled; that is, having one, three, or more longitudinal ribs, often having on the back, base, or summit, an awn or beard of different lengths, as in the oat and brome grasses, the inner pale with two separate fringed ribs, each on a fold at the side. The calyx, cup, or outer scale of the spikelet, is shown very much magnified in Fig. 4, composed of two glumes, the upper and lower, the upper glume being the larger. The glumes and pales are known also by the name of husks or chaff, and are removed if possible in cleaning the seed, as in the grains used for their meal. One or both of the glumes are sometimes wanting.

In Fig. 5 is shown the pistil magnified, consisting of the nectary, composed of one or two fleshy scales (in some plants of this family both on one side, in others entirely wanting), and the germ, ovary, or seed-bearing portion of the pistil. The stamens are also seen in the same figure, consisting each of a bag filled with a fine powder or pollen, supported upon a stalk or filament



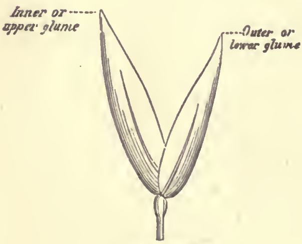
Floret magnified

Fig. 3.



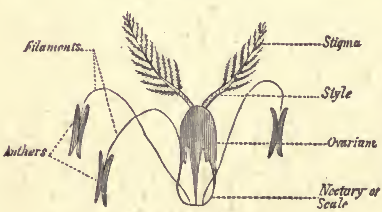
Spikelet magnified

Fig. 2.



Calyx magnified

Fig. 4.



Pistil magnified

Fig. 5.

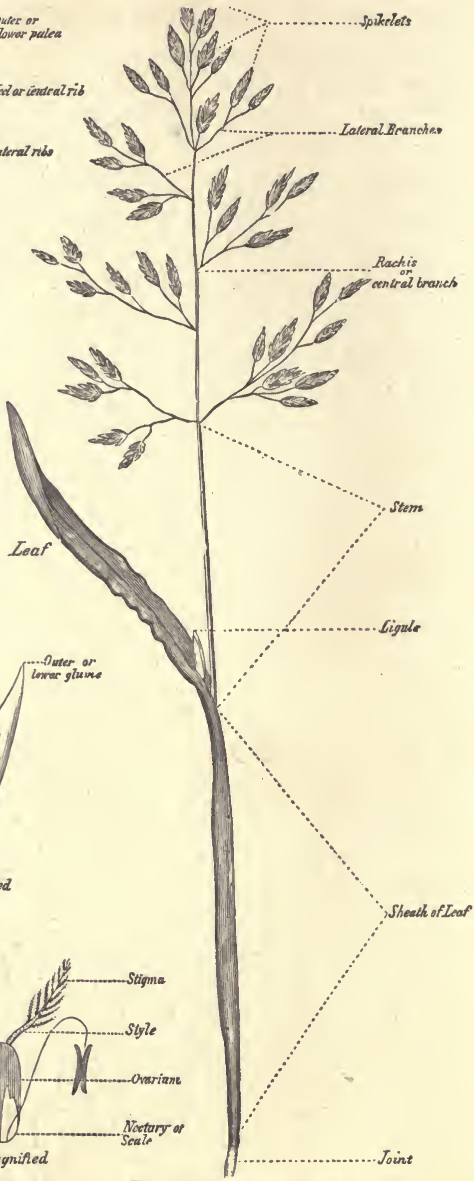


Fig. 1. Annual Spear Grass.

which is analogous to the stalk or stem of a leaf; while the bag which holds the pollen, called the anther, corresponds to the blade or body of the leaf. These are essential parts of the flower.

At a particular stage of its growth, the anther, bursting, scatters its pollen, some of which, lighting upon the summit of the stigma, is said to fertilize it, when the new seed begins to enlarge, and a germ is formed capable of producing other plants. The process is very apparent to the observation of the farmer in the case of Indian corn, on which the pollen is so abundant that it may be shaken off in clouds. It falls upon the stigmas or "silks," one of which is attached to each embryo seed or germ; and without this particle of pollen, the seed would not be capable of attaining maturity. The same arrangement is seen less plainly in the other grasses, as, for instance, in Timothy. It is found in this whole family of plants, though it is more perceptible in Indian corn, on account of its size, than in the smaller grasses.

The germ is the first part of the seed that is distinctly formed, and hence, if the seed is plucked while "in the milk," or in a green state, it will germinate the next year about as well as if it were allowed to ripen.

The anther, it will be seen, consists of two cells, — very prominent and hanging, supported on the long, slender filaments, and forked or divided at the end. The two short and smooth styles rise from the summit of the ovary, and the stigmas are feathery or rough, sometimes branched or compound. Only one seed is contained in each ovary, and each seed is covered, when mature, with a thin husk or hull called the pericarp, which originally formed the germ or ovary; and the ripe seed or fruit is only the ovary arrived at maturity. The substance or albumen of the seed of all the

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grasses is mealy or farinaceous, as wheat, for instance, or rye, or Indian corn, which are most used as seeds, on account of their size and productiveness.

These are the prominent characteristics of this great and universally diffused order of plants, constituting, as it does, the chief support of animals as well as man. They belong, as has been seen, to other plants than those commonly called grasses; the order *Gramineæ*, as I have already stated, embracing the grains, as wheat, barley, rye, and many others, while it does not include the clovers, which properly belong to the order of leguminous plants.

These characteristics, or at least the most important of them, will be very easily kept in mind, as the long, narrow, and lance-shaped leaves, and the mealy nature of the seeds, which makes so large a part of this family valuable and nutritious; but in studying the distinctive characteristics of the different species and varieties particularly valuable or interesting to an agriculturist as forage plants, it will be necessary to depend much upon the technical terms already referred to, though in the following pages these will be avoided, or explained in the context as far as possible.

It will have been observed that considerable importance is given to the flowers and seeds as distinguishing characters of the grasses. It will often be found difficult from the mere external appearance of a variety of grass to determine to what species, or even to what genus, it belongs, so great is the resemblance between the different species of this class of plants; but, with the aid of a small magnifying glass, there will very seldom be much difficulty in determining the species, especially if the plant is taken while in blossom. Indeed, it will often be possible to arrive at a conclusion from an inspection of a few of the more evident characters.

A frequent reference to figures 1, 2, 3, 4, and 5, will greatly aid the reader in becoming familiar with the technical terms applied to the organs or parts of the flower which it is desirable to understand, and by means of which he will soon learn to distinguish the different species more readily.

In giving the scientific names, the first word that occurs in parenthesis is the name of the genus; the second, that of the species; as, for instance, in Timothy (*Phleum pratense*), *Phleum* is the generic name, *pratense* the specific. A genus often contains many species.

The grasses which are described more or less minutely in the following pages are named in

TABLE I.—LIST OF THE TRUE GRASSES.

Common Name.	Botanical Name.	Time of Blossoming.	Place of Growth.
Rice Grass, ...	Leersia oryzoides, . . .	August, . .	Low, wet places.
White Grass, ...	Leersia Virginica, . . .	August, . .	Damp woods.
Catch Fly Grass, . . .	Leersia lenticularis, . .	August, . .	Low grounds.
Indian Rice, ...	Zizania aquatica, . . .	August, . .	Borders of streams.
Prolific Rice, ...	Zizania miliacea, . . .	August, . .	Wet places.
Meadow Foxtail, . . .	Alopecurus pratensis, .	May, . . .	Fields and pastures.
Floating Foxtail, . . .	Alopecurus geniculatus,	May, June,	Wet meadows, ditches.
Slender Foxtail, ...	Alopecurus agrestis, . .	July, . . .	Fields and pastures.
Wild Water Foxtail, . .	Alopecurus aristulatus, .	June to Aug.	In wet meadows.
Timothy, ...	Phleum pratense, . . .	June, July,	Fields and pastures.
Mountain Cat's-tail, . .	Phleum alpinum, . . .	August, . .	Wild mountain tops.
Rush Grass, ...	Vilfa aspera, ...	Sept., . . .	Dry, sandy soils.
Hidden Flowered Vilfa, .	Vilfa vaginæflora, . . .	Sept., . . .	Sandy & gravelly plains.
Southern Vilfa, ...	Vilfa Virginica, ...	Aug., . . .	Sandy sea-shores.
Rush Drop-seed, ...	Sporobolus junceus, . .	Aug., . . .	Dry soils.
Strong-scented Drop-seed,	Sporobolus heterolepis, .	Aug., . . .	Sandy soils.
Leaden Drop-seed, . .	Sporobolus cryptandrus,	Aug., . . .	Sandy soils.
Smooth-leaved Drop-seed,	Sporobolus compressus,	Sept., . . .	Wet bogs.
Late Drop-seed, ...	Sporobolus serotinus, .	Sept., . . .	Wet sands.
Brown Bent, ...	Agrostis canina, ...	June, July,	Fields and pastures.
Tickle Grass, ...	Agrostis scabra, ...	June, July,	Old, dry fields.
Taller Thin Grass, . . .	Agrostis elata, ...	Oct., . . .	Swamps.
Thin Grass, ...	Agrostis perannans, . .	July, Aug.,	Moist shades.
Redtop, ...	Agrostis vulgaris, . . .	July, . . .	Fields and pastures.
English Bent, ...	Agrostis alba, ...	July, . . .	Fields and pastures.
Fiorin, ...	Agrostis stolonifera, . .	July, . . .	Moist meadows.

Common Name.	Botanical Name.	Time of Blossoming.	Place of Growth.
Southern Bent, ...	Agrostis dispar, ...	July, . . .	Fields, pastures.
Annual Beard Grass, .	Polypogon monspeliensis,	June, July,	Near the coast.
Wood-reed Grass, . . .	Cinna arundinacea, . .	July, Aug,	Shady swamps.
Drooping-reed Grass, .	Cinna pendula, ...	Aug., . . .	Low woods.
Awnless Muhlenbergia,	Muhlenbergia sobolifera,	Aug., Sept.,	Open, rocky woods.
Clustering Muhlenbergia,	Muhlenbergia glomerata,	Aug., . . .	Swamps.
Mexican Muhlenbergia,	Muhlenbergia Mexicana,	Aug., . . .	Low grounds.
Sylvan Muhlenbergia, .	Muhlenbergia sylvatica,	Aug., Sept.,	Rocky woods.
Willdenow's Muhlenbergia, ...	Muhlenbergia Willdenovii	Aug., Sept.,	Open, rocky woods.
Nimble Will, ...	Muhlenbergia diffusa, .	Aug., Sept.,	Dry hills, woods.
Hair Grass, ...	Muhlenbergia capillaris,	Aug., . . .	Sandy soils.
Awned Brachyelytrum,	Brachyelytrum aristatum	June, . . .	Rocky woods.
Blue Joint Grass, . . .	CalamagrostisCanadensis	July, . . .	Wet grounds.
Glaucous Small Reed, .	Calamagrostis coarctata,	Aug., . . .	Wet grounds.
Close-flowered Sm. Reed,	Calamagrostis inexpansa,	July, . . .	Swamps.
Alpine Reed Bent, . . .	Calamagrostis Pickeringii	Sept., . . .	Mountain tops.
Purple Bent, ...	Calamagrostis brevipilis,	Sept., . . .	Pine barrens.
Woolly Bent, ...	Calamagrostis longifolia,	Sept., . . .	Sandy sea-shores.
Beach Grass, Sea Reed,	Ammophila arundinacea,	Aug., . . .	Drifting sands.
Upright Sea Lyme Grass,	Elymus arenarius, . . .	July, . . .	Drifting sands.
Black Mountain Rice, .	Oryzopsis melanocarpa,	Aug., . . .	Rocky woods.
White Mountain Rice, .	Oryzopsis asperifolia, .	May, . . .	Wooded hills.
Canadian Rice, ...	Oryzopsis Canadensis, .	May, . . .	Rocky hill-sides.
Feather Grass, ...	Stipa pennata, ...	Aug., . . .	Gardens.
Richardson's Feather Grass, ...	Stipa Richardsonii, . .	July, . . .	Pleasant mountain.
Black Oat Grass, . . .	Stipa avenacea, ...	July, . . .	Dry, sandy woods.
Porcupine Grass, . . .	Stipa spartea, ...	July, . . .	Prairies.
Poverty Grass, ...	Aristida dichotoma, . .	Sept., . . .	Sandy pine barrens
Three Awned Grass, . .	Aristida ramosissima, .	Sept., . . .	Dry prairies.
Slender Three Awned Grass, ...	Aristida gracilis, . . .	Sept , . . .	Sandy fields.
Downy Triple Awn, . .	Aristida stricta, ...	June, July,	Rocky shades.
Purple Triple Awn, . .	Aristida purpurascens,	Sept., . . .	Rocky uplands.
Prairie Triple Awn, . .	Aristida oligantha, . .	July, . . .	Prairies.
Long Awned Poverty Grass, ...	Aristida tuberculosa, .	July, Aug.,	Dry prairies.
Fresh-water Cord Grass,	Spartina cynosuroides, .	Aug., . . .	Banks of streams.
Salt Reed Grass, . . .	Spartina polystachya, .	—	Brackish marshes.
Rush Salt Grass, . . .	Spartina juncea, ...	Aug., . . .	Salt marshes, beaches.
Salt Marsh Grass, . . .	Spartina stricta, ...	—	Sea-coast.
Rough Marsh Grass, . .	Spartina glabra, ...	—	Salt marshes.
Smooth Marsh Grass, .	Spartina alterniflora, . .	Aug., Sept.,	Borders salt marshes.
Toothache Grass, . . .	Ctenium Americanum, .	—	Wet, sandy plains.
Muskit Grass, ...	Bouteloua oligostachya,	Aug., . . .	Dry lands.
Bristly Muskit, ...	Bouteloua hirsuta, . . .	—	Sandy plains.
Hairy Muskit, ...	Bouteloua curtipendula,	July, Sept.,	Stiff soils.
Naked Beard Grass, . .	Gymnopogon racemosus,	Aug., . . .	Pine barrens.

Common Name.	Botanical Name.	Time of Blossoming.	Place of Growth.
Short-leaved Beard Grass	Gymnopogon brevifolius,	Aug., . . .	Sandy soils.
Bermuda Grass, ...	Cynodon dactylon, . . .	July, . . .	Light soils.
Egyptian Grass, ...	Dactyloctenium Ægyptiacum, ...	July, . . .	Fields.
Crop, or Crab Grass, . .	Eleusine Indica, ...	June, . . .	Fields, yards.
Pointed Slender Grass, .	Leptochloa mucronata, .	Aug., . . .	Fields.
Clustering Slender Grass,	Leptochloa fascicularis, .	Aug., . . .	Brackish marshes.
Tall Redtop, ...	Tricuspis sesleroides, .	Aug., . . .	Sandy fields.
Sand Grass, ...	Tricuspis purpurea, . .	Aug., Sept.,	Sands on the coast.
Horned Sand Grass, . .	Tricuspis cornuta, . . .	July, . . .	Light soils.
Dupontia Grass, ...	Dupontia Cooleyi, . . .	—	Swampy lands.
Twin Grass, ...	Diarrhena Americana, .	Aug., . . .	Moist shades.
Orchard Grass, ...	Dactylis glomerata, . .	June, . . .	Fields and pastures.
Crested Kœleria, . . .	Kœleria cristata, . . .	July, . . .	Prairies.
Truncated Kœleria, . .	Kœleria truncata, . . .	June, . . .	Dry fields.
Pennsylvanian Eatonia,	Eatonia Pennsylvanica,	June, . . .	Moist woods.
Melic Grass, ...	Melica mutica, ...	June, . . .	Fields.
Rattlesnake Grass, . .	Glyceria Canadensis, . .	July, . . .	Wet bogs.
Obtuse Spear Grass, . .	Glyceria obtusa, ...	Aug., . . .	Borders of ponds.
Long Panicled Manna Grass, ...	Glyceria elongata, . . .	June, July,	Woods and swamps.
Meadow Spear Grass, .	Glyceria nervata, . . .	June, July,	Moist and wet meadows
Pale Manna Grass, . .	Glyceria pallida, . . .	July, . . .	Shallow water.
Water Spear Grass, . .	Glyceria aquatica, . . .	Aug., . . .	Wet soils.
Common Manna Grass,	Glyceria fluitans, . . .	June, . . .	Muddy ditches.
Pointed Spear Grass, . .	Glyceria acutiflora, . .	June, . . .	Wet lands.
Goose Grass, ...	Glyceria maritima, . .	July, . . .	Salt marshes.
Clustered Spear Grass, .	Glyceria distans, . . .	July, . . .	Salt marshes.
Spike Grass, ...	Brizopyrum spicatum, .	Aug., . . .	Salt marshes.
Annual Spear Grass, . .	Poa annua, ...	Apr. to Oct.,	Fields and pastures.
Wavy Meadow Grass, .	Poa laxa, ...	July, . . .	High, rocky hills.
Short-leaved Spear Grass,	Poa brevifolia, ...	April, May,	Rocky and moist places.
Southern Spear Grass, .	Poa flexuosa, ...	Mar., May,	Upland woods.
Wood Spear Grass, . .	Poa alsodes, ...	May, June,	Upland woods.
Weak Meadow Grass, .	Poa debilis, ...	May, . . .	Woody river banks.
Sylvan Spear Grass, . .	Poa sylvestris, ...	June, . . .	Rocky banks.
Fowl Meadow, ...	Poa serotina, ...	July & Aug.	In wet soils.
Wood Meadow Grass, .	Poa nemoralis, ...	June, . . .	Fields and pastures.
Rough-stalked Meadow,	Poa trivialis, ...	July, . . .	Fields and pastures.
June Grass, ...	Poa pratensis, ...	June, July,	Fields and pastures.
Blue Grass, ...	Poa compressa, ...	July, Aug.	Dry road-sides, pastures
Creeping Meadow, . . .	Eragrostis reptans, . .	July & Aug.	Sandy river banks.
Strong-scented Meadow,	Eragrostis poæoides, . .	Aug. & Sept.	Sandy fields.
Pungent Meadow, . . .	Eragrostis megastachya,	Aug., . . .	Sandy fields.
Slender Meadow, . . .	Eragrostis pilosa, . . .	Aug., . . .	Sandy, gravelly places.
Short-stalked Meadow, .	Eragrostis Frankii, . .	Aug., . . .	Moist sands.
Southern Eragrostis, . .	Eragrostis Purshii . . .	July, . . .	Sterile plains.
Branching Spear Grass,	Eragrostis tenuis, . . .	Aug., Oct.,	Sterile plains.

Common Name.	Botanical Name.	Time of Blossoming.	Place of Growth.
Hair-panicled Meadow Grass, ...	Eragrostis capillaris, . .	Aug., Sept.,	Sandy plains.
Meadow Comb Grass, .	Eragrostis pectinacea, .	Aug., Sept.,	Sandy plains.
Quaking Grass, ...	Briza media, ...	June, . . .	Pastures.
Small Fescue Grass, . .	Festuca tenella, ...	July, . . .	Dry, sterile soils.
Sheep's Fescue, ...	Festuca ovina, ...	June, . . .	High pastures and hills.
Hard Fescue Grass, . .	Festuca duriuscula, . .	June, . . .	Fields and pastures.
Red Fescue Grass, . . .	Festuca rubra, ...	—	Sandy places by the sea.
Meadow Fescue, ...	Festuca pratensis, . . .	June, . . .	Fields and pastures.
Tall Fescue Grass, . . .	Festuca elatior, ...	June, July,	Fields and pastures.
Slender Fescue, ...	Festuca loliacea, ...	—	Moist meadows, pastures.
Nodding Fescue, . . .	Festuca Nutans, . . .	July, . . .	Rocky woods.
Crested Dog's-tail, . . .	Cynosurus cristatus, . .	July, . . .	Fields and pastures.
Willard's Bromus, . . .	Bromus secalinus, . . .	June, July,	Fields, and in grain crops.
Smooth Brome Grass, .	Bromus racemosus, . .	June, . . .	Grain fields.
Soft Chess, ...	Bromus mollis, ...	June, . . .	Fields and pastures.
Wild Chess, ...	Bromus Kalmii, ...	June, July,	Dry, open woods.
Fringed Brome Grass, .	Bromus ciliatus, ...	July, Aug.,	Rocky hills, woods.
Meadow Brome, ...	Bromus pratensis, . . .	July, . . .	Dry, arid pastures.
Sterile Brome Grass, . .	Bromus sterilis, ...	July, . . .	Dry pastures.
Spike Grass, ...	Uniola paniculata, . . .	Aug., . . .	Sands on the coast.
Broad-leaved Spike Grass	Uniola latifolia, ...	Aug., . . .	Shaded fields.
Slender Spike Grass, . .	Uniola gracilis, ...	Aug., . . .	Sands on the coast.
Common Reed Grass, .	Phragmites communis, .	Sept., . . .	Swamps, edges of ponds.
Cane Grass, ...	Arundinaria macrosperma, ...	April, . . .	Rich soils.
Slender Tail Grass, . .	Lepturus paniculatus, .	Aug., . . .	Salt licks.
Perennial Rye Grass, .	Lolium perenne, ...	June, . . .	Fields and pastures.
Italian Rye Grass, . . .	Lolium Italicum, . . .	June, . . .	Fields and pastures.
Bearded Darnel, ...	Lolium temulentum, . .	July, . . .	Grain fields.
Many-flowered Darnel, .	Lolium multiflorum, . .	June, July,	Fields and pastures.
Couch, or Twitch Grass,	Triticum repens, ...	June, July,	Fields and pastures.
Bearded Wheat Grass, .	Triticum caninum, . . .	July, . . .	Woody banks.
Squirrel-tail Grass, . .	Hordeum jubatum, . .	June, . . .	Salt marshes.
Barley Grass, ...	Hordeum pusillum, . .	May, . . .	Brackish soils.
Two-rowed Barley, . .	Hordeum distichum, . .	June, . . .	Fields.
Four-rowed Barley, . .	Hordeum vulgare, . . .	June, . . .	Fields.
Rye, ...	Secale cereale, ...	June, . . .	Fields.
Lyme Grass, ...	Elymus Virginicus, . .	July & Aug.	Banks of rivers.
Canadian Lyme Grass, .	Elymus Canadensis, . .	Aug., . . .	River banks.
Slender Hairy Lyme, .	Elymus striatus, ...	July, . . .	River banks.
Soft Lyme Grass, . . .	Elymus mollis, ...	July, . . .	Moist soils.
Bottle-brush Grass, . .	Gymnostichum Hystrix,	July, . . .	Moist, rocky woods.
Wood Hair Grass, . . .	Aira flexuosa, ...	June, . . .	Dry, rocky hills.
Tufted Hair Grass, . . .	Aira cæspitosa, ...	June, July,	Marshy, wet bottoms.
Purple Alpine Hair Grass	Aira atropurpurea, . .	Aug., . . .	Hill tops.
Wild Oat Grass, ...	Danthonia spicata, . .	June, . . .	Dry pastures.
Downy Persoon, ...	Trisetum molle, ...	July, . . .	Rocky river banks.
Downy Oat Grass, . . .	Trisetum pubescens, . .	July, . . .	Poor, dry pastures.

Common Name.	Botanical Name.	Time of Blossoming.	Place of Growth.
Marsh Oat Grass, . . .	Trisetum palustre, . . .	June, . . .	Low grounds.
Meadow Oat Grass, . .	Avena pratensis, . . .	July, . . .	Pastures.
Yellow Oat Grass, . . .	Avena flavescens, . . .	July, . . .	Fields and pastures.
Purple Wild Oat, . . .	Avena striata, ...	June, . . .	Rocky hill-sides.
Early Wild Oat, ...	Avena praecox, ...	June, . . .	Sandy soils.
Common Oat, ...	Avena sativa, ...	July, . . .	Cultivated fields.
Tall Meadow Oat Grass,	Arrhenatherum avenaceum, ...	May, June,	Fields and pastures.
Meadow Soft Grass, . .	Holcus lanatus, ...	June, . . .	Fields and pastures.
Creeping Soft Grass, . .	Holcus mollis, ...	—	Fields and pastures.
Seneca Grass, ...	Hierochloa borealis, . .	May, . . .	Wet meadows.
Alpine Holy Grass, . .	Hierochloa alpina, . . .	July, . . .	Mountain tops.
Sweet-scented Vernal, .	Anthoxanthum odoratum	May, June,	Fields and pastures.
Reed Canary Grass, . .	Phalaris arundinacea, .	July, . . .	By running streams.
Common Canary Grass,	Phalaris Canariensis, .	July, Aug.,	Gardens.
Millet Grass, ...	Millium effusum, . . .	June, . . .	Damp, cold woods.
Double-bearing Millet, .	Millium Purshii, . . .	Sept., . . .	Moist pine barrens.
Floating Paspalum, . .	Paspalum fluitans, . .	Oct., . . .	Wet swamps.
Hairy Slender Paspalum,	Paspalum setaceum, . .	Aug., . . .	Sandy fields by the sea.
Smooth Erect Paspalum,	Paspalum læve, ...	Aug., . . .	Moist meadows.
Joint Grass, ...	Paspalum distichum, . .	July, Aug.,	Wet fields.
Finger-shaped Paspalum,	Paspalum digitaria, . .	July, Aug.,	Moist grounds.
Slender Crab Grass, . .	Panicum filiforme, . . .	Aug., . . .	Dry sands on the coast.
Smooth Crab Grass, . .	Panicum glabrum, . . .	Aug., Sept.,	Fields, waste places.
Finger Grass, ...	Panicum sanguinale, . .	Aug. to Oct.,	Neglected fields.
Agrostis-like Panic, . .	Panicum agrostoides, . .	July, Aug.,	Wet med., river banks.
Double-headed Panic, .	Panicum anceps, . . .	Aug., . . .	Wet pine barrens.
Prolific Panic Grass, . .	Panicum proliferum, . .	July, Aug.,	Brackish marshes.
Hair-stalked Panic, . .	Panicum capillare, . . .	Aug., Sept.,	Dry, sandy fields.
Autumn Panic, ...	Panicum autumnale, . .	—	Sand-hills.
Bitter Panic, ...	Panicum amarum, . . .	Aug., Sept.,	Sandy shores.
Tall Smooth Panic, . .	Panicum virgatum, . .	Aug., . . .	Moist, sandy soils.
Broad-leaved Panic, . .	Panicum latifolium, . .	June, July,	Damp thickets.
Hidden-flowered Panic, .	Panicum clandestinum,	July, Aug.,	Moist thickets.
Small-seeded Panic, . .	Panicum microcarpon, .	July, Sept.,	Moist thickets.
Yellow Panic, ...	Panicum xanthophysum,	June, . . .	Sandy soils.
Sticky Panic Grass, . .	Panicum viscidum, . .	Aug., . . .	Moist soils.
Millet, ...	Panicum miliaceum, . .	June, . . .	Cultivated grounds.
Few-flowered Panic, . .	Panicum pauciflorum, .	June, July,	Wet soils.
Polymorphus Panic, . .	Panicum dichotomum, .	June, Aug.,	Moist fields.
Worthless Panic, . . .	Panicum depauperatum,	June, . . .	Dry woods.
Warty Panic, ...	Panicum verrucosum, .	Aug., . . .	Sandy swamps.
Hungarian Grass, . . .	Panicum germanicum, .	—	Cultivated grounds.
Barn Grass, ...	Panicum crus-galli, . .	Aug., Sept.,	Rich cultivated grounds.
Bristly Foxtail, ...	Setaria verticillata, . .	—	About farm-houses.
Bottle Grass, ...	Setaria glauca, ...	July, . . .	Fields and barn-yards.
Green Foxtail, ...	Setaria viridis, ...	—	Cultivated fields.
Bengal Grass, ...	Setaria Italica, ...	—	Fields.
Burr Grass, ...	Cenchrus tribuloides, .	Aug., . . .	Sands near the coast.

Common Name.	Botanical Name.	Time of Blossoming.	Place of Growth.
Gama Grass, ...	Tripsacum dactyloides, .	Aug., . . .	Moist places on the coast
Woolly Beard Grass, . .	Erianthus alopecuroides,	Sept., . . .	Moist pine barren.
Short-bearded Erianthus,	Erianthus brevibarbis, .	Aug., . . .	Low grounds.
Finger-spiked Wood, . .	Andropogon furcatus, .	Sept., . . .	Sterile, rocky hills.
Purple-wood Grass, . .	Andropogon scoparius, .	July to Sept.,	Sterile, sandy plains.
Silver Beard Grass, . .	Andropogon argenteus,	Sept., . . .	Barren soils.
Virginian Beard Grass, .	Andropogon Virginicus,	Sept., . . .	Sandy soils.
Cluster-flowered Beard Grass, ...	Andropogon macrorus, .		Low grounds.
Indian Grass, ...	Sorghum nutans, . . .	Aug., . . .	Dry soils.
Dhourra Corn, ...	Sorghum vulgare, . . .	—	Cultivated fields.
Broom Corn, ...	Sorghum saccharatum, .	July, . . .	Fields.
Chinese Sugar-cane, . .	Sorghum nigrum, . . .	July, . . .	Cultivated grounds.
Chocolate Corn, ...	Sorghum Bicolor, . . .	Aug., . . .	Cultivated grounds.
Indian Corn, ...	Zea mays, ...	July, . . .	Cultivated grounds.

To aid the reader in finding the true name of an unknown specimen of grass, the following arrangement will be found to be very convenient, and easily understood. Let the flowers of the grass be first examined. If but one is found in each spikelet, refer to number 2, of the left-hand column, and then examine and see whether they are arranged in panicles or spikes ; if the former, then refer to number 3 of the left-hand column, and see whether they are awned or not. If awned, refer to number 4, if without awns, to number 12, of the left-hand column. If unawned, and having two glumes, refer to 13, and so on. If without glumes and aquatic, it is a zizania, or wild rice.

If in the first examination the spikelets are found to have two or more flowers, refer to number 26, of the left-hand column, and see whether the inflorescence is in panicles or spikes. If the former, refer to 27, of the left-hand column. If the latter, in spikes, refer to 39, and then see whether the spikelets are two-rowed, or one-sided. If the latter, refer to 45, and see whether the spikes are digitate and the spikelets in two rows. If they are, refer it to the genus Eleusine.

But little practice will be required to gain familiarity in thus analyzing the flowers of the grasses.

1. Spikelets with but one flower, ... 2
1. Spikelets with two or more flowers, ... 26
    2. Flowers arranged in panicles, ... 3
    2. Flowers in spikes, ... 16
3. With awns, ... 4
3. Without awns, ... 12
    4. Glumes large, ... 5
    4. Glumes minute, unequal, one hardly perceptible, ... 11
    4. Glumes none, grass aquatic, ... 2—Zizania.
5. Without abortive rudiments, ... 6
5. With an abortive rudiment of a second flower, ... 52—Holcus.
    6. Paleæ two, ... 7
    6. Paleæ three, upper awned flowers polygamous, . 65—Sorghum.
7. Palea with one awn, ... 8
7. Lower palea with three twisted awns, ... 15—Aristida.
    8. Paleæ cartilaginous or gristly, ... 9
    8. Paleæ herbaceous, ... 10
    8. Paleæ membranaceous, panicle open, ... 7—Agrostis.
    8. Paleæ membranaceous, panicle contracted, . . . 8—Polypogon.
9. Flowers sessile, or joined to the stem at the base, . . 13—Oryzopsis.
9. Flowers stipitate, fruit black, ... 14—Stipa.
    10. Flowers naked, with one stamen, ... 9—Cinna.
    10. Flowers hairy, stamens three, ... 12—Calamagrostis.
11. Stamens three, ... 10—Muhlenbergia.
11. Stamens two, ... 11—Brachyelytrum.
    12. Glumes two, ... 13
    12. Glumes none, leaves rough from the end backwards, 1—Leersia.
13. Paleæ membranaceous, ... 14
13. Paleæ leathery, spikelets all cauline, ... 56—Milium.
13. Paleæ leathery, fertile spikelets radical, ... 57—Amphicarpon.
    14. Fruit coated, or covered with a husk, ... 15
    14. Fruit naked, ... 6—Sporobolus.
15. Flowers stalked, ... 7—Agrostis.
15. Flowers sessile, ... 5—Vilfa.
    16. Flowers awned, ... 17
    16. Flowers without awns, ... 22
17. Spikes solitary, ... 18
17. Spikes many, awnless, unilateral, paleæ cartilaginous, 59—Panicum.
17. Spikelets two, fertile, ... 63—Erianthus.
17. Spikes two, polygamous, sterile flowers bearded, . . 64—Andropogon.
    18. Spikes simple, or nearly so, ... 19
    18. Spikes paniculate, or lobed, ... 21

19. Involucre none, ... 20
19. Involucre of two or more bristles, ... 60—Setaria.
19. Involucre burr-like, ... 61—Cenchrus.
20. Paleæ with awns one to three times their length, 3—Alopecurus.
20. Paleæ with awns five times their length, . . . 44—Hordeum.
21. Both glumes and paleæ awned, ... 10—Muhlenbergia.
21. Glumes awnless, single palea awned, ... 54—Anthoxanthum.
21. Paleæ two, lateral flowers staminate, ... 53—Hierochloa.
22. Flowers perfect or polygamous, ... 23
22. Spikes monœcious, ... 25
23. Spikes one-sided, ... 24
23. Spikes cylindrical, solitary terminal, ... 4—Phleum.
24. Spikes two or more, spikelets suborbicular, . . 58—Paspalum.
24. Spikes digitate or verticillate, linear, ... 59—Panicum.
24. Spikes pedunculate, in a two-sided panicle, . . . 16—Spartina.
24. Spikes sessile, in a one-sided panicle, ... 41—Lepturus.
25. Spikes all terminal, sterile above, fertile at base, . . 62—Tripsacum.
25. Fertile spikes lateral, sterile ones terminal panicled, ... 66—Zea.
26. Inflorescence in panicles, ... 27
26. Inflorescence in spikes, ... 39
27. Flowers awned, ... 28
27. Flowers without awns, ... 33
28. Lower palea awned on the back, ... 29
28. Lower palea awned on the apex, ... 32
29. Awn near the base of the palea, ... 30
29. Awn near the apex of the palea, ... 31
30. Apex bifid, awn bent, ... 50—Avena.
30. Apex bifid, awn bent, lower flower sterile, 51—Arrhenatherum.
30. Apex multifid, ... 47—Aira.
31. Paleæ with two bristly teeth, ... 49—Trisetum.
31. Paleæ bifid, ... 37—Bromus.
32. Lower palea rounded, obtuse, ... 35—Briza.
32. Lower palea entire, pointed, fruit coated, . . . 36—Festuca.
32. Awn between two teeth, twisted, ... 48—Danthonia.
33. Terminal flower perfect, ... 34
33. Terminal flower abortive, or a mere pedicel, ... 36
34. Paleæ entire, outer one mucronate, ... 35
34. Glumes unequal, like the lower abortive pale, 59—Panicum.
34. Glumes equal, longer than the palea, ... 55—Phalaris.
34. Lower palea truncate-mucronate, inner bifid, . . 38—Uniola.
34. Flowers silky-bearded on the rachis, ... 39—Phragmites.
34. Spikelets terete, paleæ seven-nerved, ... 31—Glyceria.
34. Spikelets two to six, five-nerved, ... 33—Poa.
34. Spikelets two to twenty, three-nerved, ... 34—Eragrostis.
34. Spikelets flat, lower pale laterally compressed, 32—Brizopyrum.

35. Scales two — styles two, ... 36—Festuca.
35. Scales and styles three, ... 40—Arundinaria.
36. Panicle contracted, ... 37
36. Panicle large diffuse, ... 30—Melica.
37. Lower palea one-pointed, or mucronate, ... 38
37. Lower palea pointless, ... 29—Eatonia.
37. Lower palea three-cleft, ... 24—Tricuspis.
37. Lower pale awnless, ... 25—Dupontia.
38. Stamens three, ... 28—Kœleria.
38. Stamens two, ... 26—Diarrhena.
39. Spikelets two-ranked, ... 37
39. Spikelets unilateral, ... 43
40. Glumes broad, ... 41
40. Glumes subulate, ... 42
40. Glumes none, ... 46—Gymnostichum.
41. Glumes two, in the upper spikelet only, ... 42—Lolium.
41. Glumes two, in each spikelet, ... 43—Triticum.
42. Glumes collateral, spikelets in twos or more, . . 46—Elymus.
42. Glumes opposite, spikelets solitary, ... 45—Secale.
43. One perfect among several neutral ones, ... 17—Ctenium.
43. One perfect flower below several neutral ones, ... 44
43. Spikelets conglomerate, or paniculate, ... 27—Dactylis.
43. Spikelets with more than one perfect flower, ... 45
44. Spikes dense, ... 18—Bouteloua.
44. Spikes filiform, racemed, ... 19—Gymnopogon.
44. Spikes slender, digitate, ... 20—Cynodon.
45. Spikes digitate, glumes and pale awnless, blunt, ... 22—Eleusine.
45. Spikes racemed, slender, ... 23—Leptochloa.

The order Gramineæ, or the Grass Family, embraces, as already said, plants with cylindrical stems, for the most part hollow, and closed at the joints, with leaves in two alternate rows, and sheaths open on the side opposite the blade, down to the point from which they start. The flowers are in little spikelets held in two-rowed glumes or bracts, the outer glumes generally two in number, and unequal. The stamens vary from one to six, but are usually three, in number. The ovary is simple, with two styles and two feathery stigmas; and the fruit is enclosed in a husk, called a caryopsis. This great and universally diffused order is divided by botanists into tribes, sub-tribes, genera,

species, and varieties; the tribes and sub-tribes embracing more or less genera; each genus embracing more or less species, and a species often embracing varieties. In the arrangement of the following pages each genus is numbered in its order; and the first we have is

1. Leersia. *White Grass.*

Spikelets one-flowered; flowers perfect, flattened, compressed in one-sided panicled spikes or clusters, jointed with the short pedicels. Glumes wanting, paleæ boat-shaped, flattened laterally, awnless, closed, nearly equal in length, the lower one much the broader, and enclosing a flat grain. Stamens one to six; stigmas feathery, with branching hairs; sheaths rough or prickly upwards. Perennial; swamps and low grounds. Generic name from Leers, a German botanist.

White Grass, Cut Grass, False Rice (*Leersia oryzoides*), is very common in wet, swampy places, and along the margins of sluggish streams and ditches. Stems from two to four feet high; panicle erect, spreading, with rough, slender branches; leaves narrow, long; sheaths exceedingly rough and sharp to the hand, drawn from the end downward. Florets oval and white, or whitish green; spikelets flat. Flowers in August. Said to be a native of Europe and Asia, as well as the United States. Common in most parts of the country, and often known at the South as "rice's cousin."

This beautiful grass is of no agricultural value; and the farmer should, by careful draining, encourage the growth of more valuable species in its place.

Small-flowered White Grass, Virginian Cut Grass (*Leersia Virginica*), is rather smoother than the preceding. A branch of the panicle is shown in Fig. 6. The panicle is simple, slender, the spikelets closely appressed, oblong. A magnified spikelet is shown in Fig. 7,

Fig. 7.

Fig. 8

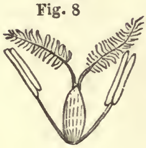

Fig. 9.

Fig. 10.

Fig. 6. Fig. 11.
Virginia Cut Grass.

opened in Fig. 8, with its stamens and pistil in Fig. 9, a part of the stigma highly magnified in Fig. 10, and a seed in Fig. 11. It is a delicate-looking and beautiful grass, but possesses no agricultural value, and may be rooted out like the preceding.

Catch Fly Grass (*Leersia lenticularis*) is smoothish, stem and panicle erect, paleæ flat, with keel and veins very hairy. Pursh observed it catching flies like the Venus' fly-trap (*Dionea muscipula*), the paleæ resembling the leaves of that plant in structure. Fig. 8 will serve to show how, by a motion similar to that of the sensitive-plant, an insect might be entrapped. Found in wet, low grounds in Ohio, Illinois, Virginia, and south. It is perennial, and flowers in July.

Rice (*Oriza sativa*) is nearly allied to this genus. See chapter on the grasses cultivated for their seeds.

2. Zizania. *Indian Rice.*

Staminate and pistillate flowers both in one flowered spikelets in the same panicles; glumes wanting or rudimentary, forming a little cup; paleæ convex, awnless in the staminate flowers, the lower tipped with a straight awn in the pistillate; stamens six, stigmas pencil-formed. Stout, often reedy aquatic grasses.

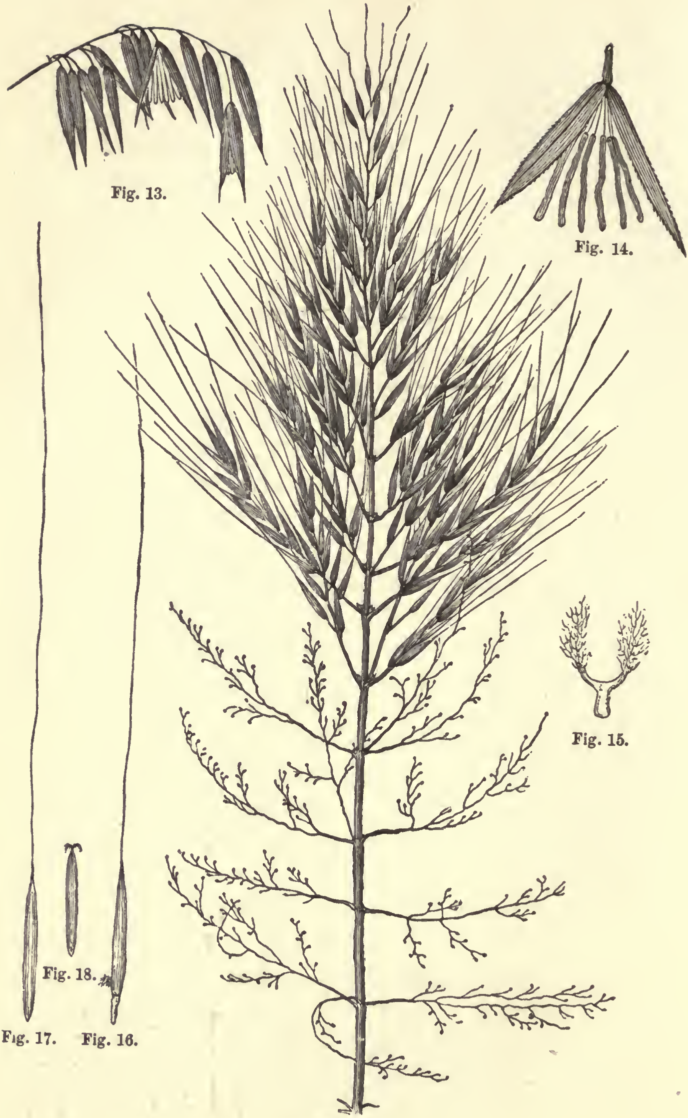

Fig. 13. Fig. 14. Fig. 15. Fig. 18. Fig. 17. Fig. 16. Fig. 12.

Indian Rice, WILD RICE, OR WATER OATS (*Zizania aquatica*), Fig. 12, is found in swampy borders of streams, in shallow water, and is common. It grows from three to nine feet in height, with flat, long, lanceolate leaves. Panicle large, pyramidal; lower branches sterile, spreading; upper, pistillate or fertile, erect. Flowers in July and August, and drops its seed, when ripe, at the slightest touch, and this furnishes food for water-fowls. It is also used for food by the aborigines. North America.

This plant is the *folle avoine* of the early settlers of Louisiana. It is exceedingly prolific, growing wild in all the Southern States, where it is said to produce two crops in a year of good hay, of which stock of every kind are very fond. It is greedily eaten when green.

In the Western States, where it is also common in the shallow water on the swampy margins of streams, it forms an important food for the Indians, who paddle a canoe among the rice, bend it over the sides, and beat out the grains with a stick.

In Fig. 13, the staminate flowers are seen as they appear at the end of a branch of the natural size. Fig. 14 represents a staminate flower, magnified; Fig. 15, the germ and stigmas; Fig. 16, a fertile or pistillate flower; Fig. 17, the same, ripe; Fig. 18, the seed. Contrary to the usual arrangement, the fertile or pistillate flowers are above the sterile or staminate ones, while the minute grains of pollen, being lighter than the atmosphere, rise when they leave the anther, and thus come in contact with the stigmas. In Indian corn, on the other hand, the grains of pollen are heavier than the surrounding air, and so fall from the sterile flowers of the "tassel" upon the styles or "silks," and thus fertilize them.

PROLIFIC RICE (*Zizania miliacea*) is also found at the South. Panicle spreading, sterile and fertile flowers intermixed. Awns short, styles united, grain smooth.

Annual; flowers in August. Grows from six to ten feet high in shallow water. Ohio, Wisconsin, and the South.

3. Alopecurus. *Foxtail Grasses.*

Spikelets one-flowered; glumes boat-shaped, compressed and keeled, nearly equal, united at the base; lower palea awned on the back below the middle, upper palea wanting; stamens three; styles mostly united; stigmas long and feathered; leaves smooth and flat. Panicle contracted into a cylindrical, soft spike, like the tail of a fox, from which it derives its generic name. Introduced and naturalized from Great Britain.

Meadow Foxtail (*Alopecurus pratensis*), Fig. 19, has an erect, smooth stem, two or three feet high, with swelling sheaths; spikes cylindrical, obtuse, equalling the sharp cone-like glumes; awn twisted, and twice the length of the blossom, Fig. 20. The spike not so long as that of Timothy. Flowers in May, in fields and pastures. Perennial — introduced.

The meadow foxtail closely resembles Timothy, but may be distinguished from it as having one palea only. The spike or head of meadow foxtail is soft, while that of Timothy is rough. It flowers earlier than Timothy, and thrives on all soils except the dryest sands and

Fig. 19. Meadow Foxtail.

Fig. 20.

gravels. It is common, but is disliked by many farmers as a field grass, being very light in proportion to its bulk.

It is a valuable pasture grass, on account of its early and rapid growth, and of its being greatly relished by stock of all kinds. The stems and leaves are too few and light to make it so desirable as a field crop. It thrives best on a rich, moist, strong soil, and shoots up its flowering stalks so much earlier than Timothy, that it need not be mistaken for that grass, though at first sight it considerably resembles it. It is superior to Timothy as a permanent pasture grass, enduring the cropping of sheep and cattle better, and sending up a far more luxuriant aftermath.

It is justly regarded, therefore, as one of the most valuable of the native pasture grasses of England, forming there a very considerable portion of the sward, and enduring a great amount of forcing and irrigation. Though forming a close and permanent sod when fully set, it does not acquire its full perfection and hold of the soil until three or four years after being sown.

The nutritive qualities of meadow foxtail are most abundant at the time of flowering. It is said to lose upwards of seventy per cent. of its weight in drying, if cut in the blossom.

The seed of meadow foxtail is covered with the soft and woolly husks of the flower, while the larger glume is furnished with an awn. There are five pounds of seed in a bushel, and seventy-six thousand seeds in an ounce. An insect attacks the seed while it is forming, and it is also subject to blight; and hence good seed is somewhat difficult to procure, and is held at a high price.

Slender Foxtail (*Alopecurus agrestis*), Fig. 21, is rarely found here, but is sometimes introduced in for-

Fig. 25.

Fig. 23.

Fig. 21. Slender Foxtail.

Fig. 22.

Fig. 24. Floating Foxtail.

eign seed. It may be recognized by its long, slender panicle, tapering at each end, and the long awn which

projects beyond the pales. In Figs. 22 and 23 the flowers are seen. It is distinguished from meadow foxtail by its slender panicle, its larger spikelets, its larger ligule, and the roughness of the stem and leaves. It possesses no particular agricultural value. Flowers in July. Annual. Native of Great Britain.

FLOATING FOXTAIL (*Alopecurus geniculatus*) has a stem ascending, bent, and forming knees at the lower joints, as shown in Fig. 24; awn projecting beyond the palea, Fig. 25, which is rather shorter than the obtuse glumes; anthers linear, upper leaf as long as its sheath; root perennial, fibrous; joints smooth, long, and narrow, of a purple tinge; leaves flat, sharp, roughish on both sides, serrated on the edge. Inflorescence simple panicled; spikelets numerous, compressed, erect, with a one-awned floret as large as the calyx. Floret of one palea, awn slender. Found in moist meadows, ditches, ponds, and slow streams, floating on the water. It is distinguished from meadow foxtail in having the upper sheath about the length of its leaf, and by the projecting awn, while in the meadow foxtail the upper sheath is more than twice the length of its leaf. Flowers in May and June.

It is a grass not much relished by stock of any kind, while it yields but a small amount of herbage.

The WILD WATER FOXTAIL (*Alopecurus aristulatus*) also grows in wet meadows, but is of no special agricultural value. Native of Great Britain.

4. PHLEUM. *Cat's-Tail.*

Panicle spiked, spikelets compressed, palea shorter than the awned glumes, the lower one truncate, usually awnless; styles distinct, filaments hairy, spike dense, rough, or harsh. So called from an ancient Greek term

signifying cat's tail, the name by which it is still most frequently known in Great Britain.

Fig. 26. Timothy.

TIMOTHY, HERD'S GRASS (*Phleum pratense*). Fig. 26. Spikes cylindrical or elongated; glumes hairy on the back, tipped with a bristle less than half their length; leaves long, flat, rough, with long sheaths; root perennial, fibrous on moist soils, on dry ones often bulbous. Grows best on damp, peaty soils. Flower Fig. 27. The name of Timothy, by which it is more generally known over the country, was obtained from Timothy Hanson, who is said to have cultivated it extensively, and to have taken the seed from New York to Carolina. Its culture was, according to some accounts, introduced into England, from Virginia, by Peter Wynche, about the years 1760 or 1761.

It is frequently called Herd's grass in New England and New York, and this was the original name under which it was cultivated; it was derived from a man of that name, who, according to Jared Eliot, found it growing wild in a swamp in Piscataqua, N. H., more than a century and a

Fig. 27.

half ago, and began to cultivate it. In Pennsylvania, and states further south, this name is applied to *Agrostis vulgaris*, or the redtop of New England.

Sinclair states, as the result of the experiments, about thirty years ago, at Woburn Abbey, under the auspices of the Duke of Bedford, and with the assistance of Sir Humphrey Davy, that the crop when ripe exceeds in nutritive value the crop at the time of flowering. This conclusion is sustained by the more recent investigations of Prof. Way, whose elaborate analyses of the grasses will be found on a subsequent page. This might be inferred from the size and weight of the mealy seeds when the grass is ripe, as many as thirty bushels of which having been known to be produced on a single acre.

As a crop to cut for hay it is probably unsurpassed by any other grass now cultivated. Though somewhat coarse and hard, especially if allowed to ripen its seed, yet if cut in the blossom, or directly after, it is greatly relished by all kinds of stock, and especially so by horses, while it possesses a large percentage of nutritive matter in comparison with other agricultural grasses. It is often sown with clover, but the best practical farmers are beginning to discontinue this custom, on account of the different times of blossoming of the two crops. Timothy being invariably later than clover, the former must often be cut too green, before blossoming, when the loss is great by shrinkage, and when the nutritive matter is considerably less than at a little later period; or, the clover must stand too long, when there is an equally serious loss of nutritious matter and of palatable qualities in that.

Timothy thrives best on moist, peaty or loamy soils, of medium tenacity, and is not suited to sandy or light gravelly lands; for though on such soils, by great care, it can be made to grow and produce fair crops, some

other grasses are better suited to them, and more profitable. It grows very readily and yields very large crops on favorable soils. I have known instances where its yield was four tons to the acre of the best quality of hay, the Timothy constituting the bulk of the grass. It is cultivated with ease, and yields a large quantity of seed to the acre, varying from ten to thirty bushels on rich soils.

In one respect, perhaps, it must be admitted that this grass is inferior to meadow foxtail, and that is, in the quality of its aftermath; for while that of the latter is very great, the aftergrowth of Timothy is comparatively slight, and if allowed to stand too long and then mown in a dry time, it starts so slowly as to leave the ground exposed to the scorching rays of the sun, unless indeed there happens to be a rapid growth of clover to protect it. The comparative value of this grass will be referred to hereafter.

It is proper to say, in this connection, that it is frequently attacked by an insect apparently just before the time of blossoming, which causes the stalk to die. The ravages of this insect seem to have increased within the last few years. My attention has been repeatedly called, by observing and practical farmers, to the large number of Timothy-stalks killed by this devouring insect. No means of preventing its ravages are as yet known.

MOUNTAIN CAT'S-TAIL (*Phleum alpinum*) is a grass that grows to the height of from six to twelve inches, on mountain and hill tops in New Hampshire, and high northern latitudes, and is easily distinguished by its short, bristly spike or panicle, seldom exceeding an inch in length. It is of little or no agricultural value, since it is rarely eaten even by sheep. Blossoms in July.

5. Vilfa. *Rush Grass.*

Spikelets in a contracted or spike-like panicle, one-flowered; glumes keel-shaped, the lower one smaller; pales awnless, nearly equal, generally longer than the glumes; stigmas feathery, seed or grain oblong.

Rough-leaved Vilfa, Rush Grass (*Vilfa aspera*), grows from two to four feet high on sandy soils and old fields. Lower leaves long, rigid, and rough on the edges, tapering to a long twisted point; sheaths partly enclosing the panicle; seed oval, oblong. Flowers in September. Perennial. Of no agricultural value.

Hidden Flowered Vilfa (*Vilfa vaginæflora*) is an annual, with many slender stems, six to twelve inches long, leaves awl-shaped, pales nearly equal, and about the length of the nearly equal glumes. This grass is common on barren, sandy soils, in most parts of the country from New England to Illinois, and especially so at the South. Of no known agricultural value.

6. Sporobolus. *Drop-seed Grass.*

Spikelets generally one, sometimes two flowered, in a contracted or open panicle. Seed loose when ripe, whence the name of the genus, from two Greek words, signifying to cast forth.

Rush-like Drop Seed (*Sporobolus junceus*) is a perennial grass, with long, folding, narrow, rigid leaves, with a loose panicle, flowering in August, spikelets long and shining. Prairies Wisconsin, and at the South.

Strong-scented Vilfa (*Sporobolus heterolepis*).—Leaves twisting, thread-like, rigid, the lowest as long as the stem, which is usually from one to two feet high; panicle pyramidal, loose, open; glumes very unequal;

lower awl-shaped, upper taper-pointed, and longer than the lower pales. Perennial, flowering in August. The plant emits a strong odor. Connecticut, New York, and the Western States to Illinois.

LARGE-PANICLED VILFA (*Sporobolus cryptandrus*).—Panicle lead-colored, pyramidal; base usually enclosed in the upper sheath, from which the panicle appears to burst with spreading branches; flowers awnless; lower glume very short; stem from one to three feet high; stamens three, anthers yellowish, styles distinct, stigmas white. Grows on sandy soils in New York, and at the South and West, where it is common.

CLOSE-FLOWERED DROP SEED (*Sporobolus compressus*).—A smooth, leafy grass, with stout, flat stems, found in bogs in the pine barrens of New Jersey, where it forms tussocks from one to two feet high. Of no agricultural value.

LATE DROP SEED (*Sporobolus serotinus*) is sometimes found in low, swampy places, with smooth, slender, flattish stems; leaves few and slender; panicle spreading, with hairy branches; glumes ovate, obtuse, and half the length of the palea. Flowers in September. It is a delicate grass, of no special agricultural value.

7. AGROSTIS. *Bent Grass.*

One-flowered spikelets in a loose, open panicle; glumes nearly equal, the lower pointless, and longer than the paleæ, which are thin and naked; stamens three; perennial.

TALLER THIN GRASS (*Agrostis elata*).—A stout grass, from two to three feet high. Spikelets crowded on the branches of the spreading panicle above the middle; lower palea awnless; upper wanting. In swamps, from New Jersey southward.

Thin Grass (*Agrostis perennans*).— Panicle diffusely spreading, pale green; branches short, divided, and flower-bearing from or below the middle; found in damp, shaded places. Perennial. Flowers in June and July.

Hair Grass or Fly-away Grass, Tickle Grass (*Agrostis scabra*), is another species belonging to this genus, with a panicle very loose and spreading, *purplish;* the long capillary branches flower-bearing near the apex; stems slender, one to two feet high; leaves short and narrow. Flowers in June and July. Common in old fields and drained swamps. It is of no particular agricultural value.

The large, loose panicles are exceedingly delicate and brittle when the plant is ripe and dry, and easily break away from the stalk, when they are blown about by the wind scattering their seeds far and wide; and hence it is frequently called "Fly-away Grass," illustrating one of the admirable contrivances of nature for the distribution of the seeds of grasses and other plants.

Brown Bent or Dog's Bent Grass (*Agrostis canina*), another species of *agrostis*, has for its specific characters an erect, slender, spreading panicle; root perennial and creeping; stem erect, slender; leaves flat and linear. The palea shorter than the glume, and furnished with a long, bent awn on the back, a little below the middle; spikelets at first greenish, afterwards brown or slightly purple. Meadows and pastures, and wet, peaty places — introduced. Flowers in June and July. It is of no special agricultural value.

The Alpine Brown Bent (*Agrostis canina*, var. *alpina*), the Upright Flowered Bent, and many other species, might be mentioned; but, of all the species of this genus, the redtop and whitetop are the most common as agricultural grasses among us.

REDTOP, FINETOP, BURDEN'S GRASS, HERD'S GRASS of Pennsylvania and Southern States (*Agrostis vulgaris*), Fig. 28.—Stems erect, slender, round, smooth, and polished; roots creeping, panicle oblong, leaves linear, ligule very short; lower palea mostly awnless, and three-nerved. Flowers in July. A magnified flower is shown in Fig. 29. In pastures and moist meadows very common—introduced. The term *agrostis* was the ancient Greek word for field, and was applied to all varieties of grass that grew there.

Fig. 28. Redtop.

This valuable grass, so common in all our cultivated fields, has been an inhabitant of our soils for more than a century. It was called simply English Grass by Eliot, Deane, and other early writers, and by the English, Fine Bent. Most of the grasses of this genus are known in England under the name of "Bent Grass," of which there are many species.

Fig. 29.

Redtop is often sown with Timothy and common red clover, in which case the clover of course soon disappears, when Timothy follows, after which redtop usually takes its place, and, with some wild grasses, forms a close sward. In Pennsylvania, and states further south, it is universally known as Herd's Grass — a name applied in New England and New York to *Phleum pratense* alone. It is of somewhat slow growth, but of good or medium quality, suited to moist soils, though common to all.

This grass is probably rather overrated by us. It makes a profitable crop for spending, though not so large as that obtained from Timothy. It is a good permanent grass, standing our climate as well as any other, and consequently well suited to our pastures, in which it should be fed close; for, if allowed to grow up to seed, the cattle refuse it; and this seems to show that it is not so much relished by stock as some of the other pasture grasses. The fact that cattle eat any grass greedily in the spring, is no proof of its excellence or nutritious qualities; since then all grasses are tender and full of juice, and many varieties of both grasses and shrubs are readily eaten, which, at a more advanced stage of growth, are refused.

It is to be regretted that Professor Way, in his valuable investigations into the nutritive value of the grasses, did not include this in the list analyzed by him. At present we have no accurate and reliable means of comparison of this with other species of grass, as in the case of many other species.

This grass is known by various names, and is greatly modified by soil and cultivation. On a moist, rich soil it grows larger than on a poor, thin soil; and not only larger, but has a darker, purplish color, with a stem varying from eighteen inches to two or two and a half feet high; while on thin, poor, gravelly soils, it seldom

grows over twelve inches, and often not over five or six inches high, while it has a lighter color. In the latter situations it goes by the name of Finetop, and is universally seen in old, dry pastures. In some sections, where it is highly esteemed, it goes by the name of Burden's or Borden's Grass; in others, of Rhode Island Bent; but I am unable to discover any difference between these and redtop, except that produced by varieties of soils; and, on inquiring of some of the largest dealers in seeds, I find that orders for all these are supplied from the same seed.

Finetop may be regarded as a variety of redtop, produced by the character of the soil.

English Bent, Whitetop, Dew Grass, White Bent, Bonnet Grass (*Agrostis alba*). Stem erect, round, smooth, polished, having four or five leaves with *roughish* sheaths; striated, upper sheath longer than its leaf, crowned with a long, acute, ragged ligule; joints smooth; branches numerous, recumbent, rooting at the lower joints where they come in contact with the ground, as shown in figure 30; panicle somewhat narrower than in redtop, lightish green, or with a slight tinge of purple; lower or inner palea one half the length of the upper, and shorter than the glumes; five-nerved, awnless, perennial. Native of Europe.

Whitetop may be known from redtop by the sheaths being rough to the touch from above downwards, and the ligule being long and acute, and the keel of the large glume of the calyx toothed nearly to the base. In redtop the sheaths are smooth, ligule short and obtuse, and the keel of the large glume toothed only on the upper part.

It may be known from Brown Bent (*Agrostis canina*), by having an inner palea in its floret, while in Brown Bent the inner palea is wanting. It is very

common on the Connecticut River meadows, where it appears to be indigenous, and is there called the English Bent. It is often used in the manufacture of bonnets.

Fig. 30. Fiorin Grass.

FIORIN (*Agrostis stolonifera*), Fig. 30, is only a variety of English bent, which gained great notoriety some years ago in Ireland and England, volumes having been written in its praise, while it received the execrations of those who found it troublesome to eradicate, on account of its creeping and stoloniferous roots. It belongs peculiarly to moist places, which are occasionally overflowed, and is sometimes known as the BROAD-LEAVED CREEPING BENT. In the Woburn experiments it was found to be inferior in nutritive value to orchard grass (*Dactylis glomerata*) and meadow fescue, and superior to meadow foxtail. A magnified flower of this grass is shown in Fig. 31.

Fig. 31.

The Southern Bent (*Agrostis dispar*), Fig. 32, is a native of this country, and has been highly extolled in France. It was at one time highly commended in England, but was very soon discarded. It furnishes a hay of rather coarse quality, and yields a large produce on good, deep sands and calcareous soils. It tillers much, and when once rooted is very vigorous and lasting, and consequently makes a good pasture grass. It is similar in appearance to some of the broad-leaved varieties of redtop, and is said to yield more than redtop. It has stronger and more numerous creeping roots, broader leaves, and more upright leafy stems. It is most frequently met with in the Southern States, and in the south of France. Fig. 33 represents

Fig. 32. Southern Bent.

Fig. 33.

the flower of this grass magnified. I am not aware that it has been cultivated in this country.

8. Polypogon. *Beard Grass.*

Panicle contracted, spike-like, with one-flowered spikelets; glumes or scales nearly equal, with long awns; stamens three; grain free.

Annual Beard Grass (*Polypogon monspeliensis*) is occasionally found near the coast. It may be known by having glumes with awns more than twice their length, growing from ten to fifteen inches high; stem erect, round, and a little rough; five or six leaves, flat, rather broad and acute; panicle dense, spikelets one-flowered — introduced. It is easily distinguished by the length of its awns or beards. Of no agricultural value. Found at the Isle of Shoals and on the coast southward.

9. Cinna. *Wood Reed Grass.*

Glumes acute, strongly keeled; the lower smaller, smooth, naked; lower longer than the upper, with a sharp awn on the back. Stamen one; grain oblong, free; perennial. Grasses somewhat sweet-scented, from two to seven feet high.

Wood Reed Grass, Indian Reed, Reedy Cinna (*Cinna arundinacea*), has spikelets, one-flowered, feathered; glumes lanceolate, acute, strongly keeled, paleæ like the glumes, short-awned; perennial. Stems erect and reed-like, three or four feet high. The spikelets are green, or of a slight purplish tinge. Moist woods and swamps; common at the West and South, as well as northward. Flowers in July and August. Panicle large, hairy, rather dense. A large, rank grass, differing from others in having but one stamen in each flower. Of no special agricultural value.

Drooping Reed Grass (*Cinna pendula*). — Branches of the loose panicle long and hairy, drooping. Spikelets about half the size of those in the preceding species. Grows in moist woods; perennial, flowering in August. Found around Lake Superior.

10. Muhlenbergia. *Drop-seed Grass.*

Spikelets one-flowered in contracted slender panicles. Glumes minute; paleæ usually hairy, bearded at the base, herbaceous, the lower three-nerved, pointed, or awned at the tip. Stamens three. Named from Dr. Muhlenberg, a distinguished American botanist.

The Awnless Muhlenbergia (*Muhlenbergia sobolifera*) is sometimes found in open, rocky woods, from New England to Michigan, and south. It grows from one to two feet high, with a simple contracted panicle, very slender; glumes long, pointed, nearly equal; root perennial, creeping, woody; leaves pale-green, sheaths open, ligule wanting. Flowers in August and September. Of no known agricultural value.

Clustering Muhlenbergia (*Muhlenbergia glomerata*). — From one to two feet high, stems upright, somewhat branched; panicle oblong, linear, contracted into an interrupted glomerate spike, with long peduncles, or flower-stalks, and awned glumes; perennial. Flowers in August and September. Common in swamps and low grounds. Of no agricultural value.

The Mexican Muhlenbergia (*Muhlenbergia Mexicana*), another species of this genus, has been mistaken by some for our fowl meadow. It has an erect stem, two to three feet high, much branched; panicles lateral and contracted, branches densely spiked and clustered, green or purplish; glumes pointed, awnless, and unequal. It is perennial. Flowers in August. Frequently regarded as a troublesome weed in low grounds, the

borders of fields, and even in gardens, where its spreading roots are difficult to eradicate. Cattle eat it very readily, and, as it blossoms late in the season, it is of some value.

The SYLVAN MUHLENBERGIA (*Muhlenbergia sylvatica*) is also rather common in low, rocky woods. Its stem is ascending, from two to four feet high, branched, spreading diffusely; panicles contracted, densely flowered; glumes nearly equal, bristle pointed, lower palea one-awned, twice or three times the length of the spikelets. Flowers in August and September.

WILLDENOW'S MUHLENBERGIA (*Muhlenbergia Willdenovii*) is also not uncommon in rocky woods, growing about three feet high, with a slender, simple stem, contracted panicle, loosely flowered, glumes sharp-pointed, half as long as the lower palea, which has an awn from three to four times the length of the spikelet.

NIMBLE WILL (*Muhlenbergia diffusa*) is common at the West, in Kentucky, Tennessee, and southward, where it forms a pasture grass of some value. Its stems are diffusely branched, from ten to eighteen inches high; panicles slender, contracted; glumes minute; awn nearly twice as long as the palea. It is found on dry hills and in woods. Flowers in August and September; perennial. Cattle eat it very readily.

HAIR GRASS.—Still another species, not unfrequently called Hair Grass (*Muhlenbergia capillaris*), is sometimes found on sandy soils, from New England to Kentucky, and at the South.

None of the grasses of this American genus are of great value for agricultural purposes, except as they add considerably to the mass of living verdure which clothes our low lands in beauty to delight the eye and swell the heart of the lover of nature.

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11. Brachyelytrum. *Brachyelytrum.*

Glumes two, very minute, lower scarcely to be seen; lower pale with a long bristle at the top, upper with rudimentary flower at the base; perennial.

The Erect Muhlenbergia, or Awned Brachyelytrum (*Brachyelytrum aristatum*), is often found in rocky woods, on the sides of Wachuset Mountain, and in many other similar situations. Flowers in June and July. Common also at the West.

12. Calamagrostis. *Reed Bent Grass.*

One-flowered spikelets, open panicle, contracted or spiked; glumes keeled, about equal to the paleæ, around which, at the base, is a thick tuft of white bristly hairs; lower pale generally with a slender awn on the back; stamens three; grain free.

Blue Joint Grass (*Calamagrostis Canadensis*).— Stems three to five feet high, grayish; leaves flat; panicle often purplish; the glumes acute, lanceolate; lower palea not longer than the very fine hairs, bearing an extremely delicate awn below the middle, nearly equal to the hairs. Flowers in July.

Blue Joint Grass is very common on low grounds. It is generally considered a valuable grass, and is eaten greedily by stock in the winter, being thought by some to be nearly as nutritious as Timothy. It grows so rank and luxuriant on soils suited to it that an immense crop of valuable hay is often made from it.

Crowded Calamagrostis, or Glaucous Small Reed (*Calamagrostis coarctata*), is also somewhat common in our wet meadows, open swamps, and along low river banks. Its stems are from three to five feet high; seed hairy, crowned with a bearded tuft; lower palea shorter

than the taper-pointed tips of the lanceolate glumes, almost twice the length of the hairs, with a rigid, short awn above the middle.

Close-flowered Small Reed (*Calamagrostis inexpansa*) appears with a contracted panicle, longer than that of the preceding species; stem about three feet high, erect; leaves smooth. The panicle is usually from four to six inches long, and slender; the lateral branches short, four or five together, rough. This is distinguished from the last by a more slender and less crowded panicle. Flourishes in swamps and boggy places.

Alpine Reed Bent (*Calamagrostis Pickeringii*) is a species found near the summit of the White Mountains, of New Hampshire. Of no agricultural value.

Purple Bent (*Calamagrostis brevipilis*) is a species found in the swamps and pine barrens of New Jersey.

Woolly Bent (*Calamagrostis longifolia*) is found along the sandy shores of the lakes of northern Michigan, and further to the north-west. Sheaths clothed with wool.

Beach Grass, Sea-sand Reed, Mat Grass (*Calamagrostis arenaria*, or *Ammophila arundinacea*), Fig. 34, grows to the height of two or three feet, with a rigid culm, from stout roots running often to the distance of twenty or thirty feet; leaves wide, rather short, of a sea-green color; panicle contracted into a close, dense spike, from six to twelve inches long, nearly white. It is found in the sands of the sea-shore, where its thick, strong, creeping, perennial roots, with many tubers the size of a pea, prevent the drifting of the sand from the action of the winds and waves, thus forming a barrier against the encroachments of the ocean.

Fig. 34. Beach Grass.

This grass is very generally diffused on sea-coasts over the world, and is found inland on the shores of Lake Superior. It has also been cultivated by way of experiment, and with success, on the sands at Lowell, Massachusetts, and still further up on the banks of the Merrimack River. Though not cultivated for agricultural purposes, it is of great value in protecting sandy beaches. It is preserved in England and Scotland by act of parliament. Flowers in August.

In the year 1853, I was requested by the late T. W. Harris to make this grass a special study, in the course of my observations; and since that time I have tried, by personal inquiries and by correspondence, to collect whatever there might be of interest in relation to it. As it is of national importance in protecting our sandy coasts, some account of its culture may not be inappropriate or uninteresting.

The town of Provincetown, once called Cape Cod, where the Pilgrims first landed, and its harbor, still called the harbor of Cape Cod, — one of the best and most important in the United States, sufficient in depth for ships of the largest size, and in extent to anchor three thousand vessels at once,— owe their preservation to this grass. To an inhabitant of an inland country, it is difficult to conceive the extent and the violence with which the sands at the extremity of Cape

Cod are thrown up from the depths of the sea, and left on the beach in thousands of tons, by every driving storm. These sand-hills, when dried by the sun, are hurled by the winds into the harbor and upon the town. A correspondent at Provincetown says: "Beach grass is said to have been cultivated here as early as 1812. Before that time, when the sand drifted down upon the dwelling-houses, — as it did whenever the beach was broken,— to save them from burial, the only resort was to wheeling it off with barrows. Thus tons were removed every year from places that are now perfectly secure from the drifting of sand. Indeed, were it not for the window-glass in some of the oldest houses in these localities, you would be ready to deny this statement; but the sand has been blown with such force and so long against this glass, as to make it *perfectly ground.* I know of some windows through which you cannot see an object, except to remind you of that passage where men were seen 'as trees walking.'"

Congress appropriated, between the years 1826 and 1839, about twenty-eight thousand dollars, which were expended in setting out beach grass near the village of Provincetown, for the protection of the harbor. From the seed of this grass it is estimated that nearly as much ground has become planted with it as was covered by the national government. In 1854 five thousand dollars were wisely expended by the general government in adding to the work; and the experience of former years was of great value to the efficiency of this latter effort. The work of fortification or protection is not yet complete. The eastern part of the harbor is much exposed to injury from the sand, which now empties itself by thousands of tons, during every north wind, into it.

"It may be proper to state," says the writer quoted

above, "that this town does much in the way of '*beach-grassing*' by its '*beach-grass committee*,' whose duty it is to enter any man's enclosure, summer or winter, and set out grass, if the sand is uncovered and movable. By this means we are now rid of sand-storms, which were once the terror of the place, being something like snow-storms, for drifts, which were to be removed. Our streets are now hardened with clay, which has been imported; and, instead of its being buried, as it would once have been in a few days, I notice that the surveyors have to resort to sprinkling it with sand in wet weather, so effectually has the culture of beach grass answered its end.

"The mode of culture is very simple. The grass is pulled up by hand and placed in a hole about a foot deep, and the sand pressed down about it. These holes are dug about one foot and a half apart. The spring is the usual time of planting, though many do this work in the fall or winter. The roots of the grass, from which it soon covers the ground, are very long. I have noticed them ten feet, and I suppose upon high hills they extend down into wet sand."

Many years ago, the beach which connects Truro and Provincetown was broken over, and a considerable body of it swept away. Beach grass was immediately planted, and the beach was thus raised to sufficient height, and in some places into hills. The operation of it is like that of brush or bushes, cut and laid upon the ground, in accumulating snow in a drifting wind. The sand is collected around the grass, and, as the sand rises, the grass also rises to overtop it, and will continue to grow, no matter how high the sand-hill may rise; and this process goes on over the whole surface of the plantation, and thus many acres have been raised far above their original level.

A committee of the Legislature, appointed in 1852, to inquire into the means of preserving Cape Cod Harbor, in speaking of the beach between the ocean on the north and the channel of East Harbor, — and which is all that prevents the sea from breaking over into Cape Cod Harbor,—say: "This tract consists of loose sand, driven about by every high wind, which throws it up in heaps like snow-drifts. The wind, from any point from north-east to north-west, drives the sand directly from said beach into the channel of East Harbor, and is carried by a strong current into the north-east part of Cape Cod Harbor. The ocean on the north is wasting this narrow beach away in every storm, and the current in East Harbor channel undermining and destroying it on the south. The decay of said beach has been on the increase for several years; it has narrowed within seven or eight years, by the tide that runs through East Harbor channel, from eight to ten rods. Where the mail-stage travelled only one year since, is now the channel, with six feet of water at low tide, and from twelve to fourteen feet at high water."

The first effort made by the state for the preservation of this important harbor appears to have been in 1714. The town was incorporated in 1727, and was at that time a place of some extent; but the inhabitants soon began to leave, and in less than twenty years it was reduced to two or three families. After the Revolution the place revived, and is now a thriving town.

The object of the law of 1714 was to arrest the destruction of the trees and shrubbery on the province lands, and on the preservation of which it was thought the harbor depended, as they prevented the drifting of the sand.

In 1824 commissioners were appointed by the state

government to examine the subject, and report what action was necessary to prevent the rapid destruction of the harbor. They recommended an act to prevent the destruction of beach grass, and reported that the sum of thirty-six hundred dollars would be necessary to set out that plant, make fences, &c. The Legislature, in 1826, applied to Congress for that sum; and Congress has, at different times, made appropriations to the amount of about thirty-eight thousand dollars, which seem to have failed in some measure to accomplish the object intended, and East Harbor is still rapidly filling up.

Many years ago, it was as customary to warn the inhabitants of Truro and some other towns on the Cape, every spring, to turn out to plant beach grass, as it was in the inland towns to turn out and mend the roads. This was required by law, with suitable penalties for its neglect, and took place in April.

A farmer, of much practical knowledge of this subject, says: "Since the cattle have been kept from the beaches, by the act of the Legislature of 1826, the grass and shrubs have sprung up of their own accord, and have, in a great measure, in the westerly part of the Cape, accomplished what was intended to be done by planting grass. It is of no use to plant grass on the high parts of the beach. Plant on the lowest parts and they will raise, while the highest places, over which the grass will spread, are levelling by the wind. To preserve the beach, it must be kept as level as possible.

"Beach grass is of but little value except to prevent our loose, sandy beaches from being drifted about by the wind. We have but one species, and this is fast spreading over our upland, making it useless for cultivation. Land that would produce from twenty to twenty-five bushels of Indian corn to the acre, with-

out any manure, twenty-five or thirty years ago, is now overrun with beach grass, and will produce nothing else. If the dead grass is burnt off in the spring, it will make a pretty good pasture for cattle and horses. It keeps green longer than any other grass we have. It can be cultivated from the seed or by transplanting. Our loose, sandy beaches are the most suitable for its growth."

Beach grass seems to require the assistance of some disturbing causes to enable it to attain its full perfection. The driving winds in some localities are sufficient, while in other places, where it does not thrive so well, it is probable that an iron-tooth harrow would greatly improve and aid its growth. It has been extensively cultivated or propagated from the seed on many parts of Cape Cod, on Nantucket, and in fact to considerable extent all along our coast. It comes in of itself along Nantasket beach from seed borne by the tides, probably, from the Cape. It has been extensively used, at times, in this country, for the manufacture of coarse paper, though, if I am rightly informed, its manufacture has been discontinued in Massachusetts. In other countries it is manufactured into door-mats and brushes, mats for pack-saddles, meal-bags, and hats, and into ropes for various purposes.

13. Oryzopsis. *Mountain Rice.*

Spikelets greenish and rather large, one-flowered; glumes several-nerved, nearly equal, awnless, longer than the oblong flower; scales linear, long as the ovary; inflorescence in narrow panicles.

Black Mountain Rice (*Oryzopsis melanocarpa*) is a common grass in dry, rocky woods, with a leafy stem from two to three feet high, a simple panicle, paleæ or husks of the seed blackish when ripe, the lower one

surrounding the upper, with a straight awn at the tip, nearly an inch long. Stamens three, anthers linear, yellow; styles distinct. Flowers in August. Not cultivated.

White Mountain Rice (*Oryzopsis asperifolia*) is also common on steep, rocky hillsides, and in dry woods. Stems clasped by sheaths, bearing a mere rudimentary blade, overtopped by the long and rigid linear leaf from the base; awn two or three times the length of the hairy whitish husks or paleæ. Perennial, growing from a foot to eighteen inches high. The lower or radical leaves remain green through the winter. The large seeds are abundantly farinaceous, and make a very white and fine flour; but the grain drops so easily as to make it impracticable to gather it in large quantities.

Smallest Oryzopsis, or Canadian Rice (*Oryzopsis Canadensis*), is another species sometimes found. These grasses are easily distinguished from each other. The first has an awn thrice the length of the blackish palea; the second, an awn two or three times the length of the whitish palea; the third, an awn short, deciduous, or wanting. The first grows from two to three feet high; the second, from ten to eighteen inches; the third, from six to fifteen inches. Natural habitat, dry, rocky woods. Perennial. Not cultivated.

It may be proper to remark, in passing, that many grasses which are now worthless, or of no known value in agriculture, might be made very useful to cultivate for the purpose of turning in green for manure.

The same may be said of many of the rank weeds which are now regarded as the pests of our fields and roadsides. Some of them, if sown on winter grains, would spring up luxuriantly after the grain was removed, drawing much of their nutriment from the air, and corporifying it, as it were, to be turned in while still green, with the stubble, and thus add vastly to the fertility

and productiveness of the soil. For this purpose those kinds which produce a large quantity of small seeds, and a large, luxuriant growth of leaves, are best. The perennials might be sown with winter grains, the annuals with spring.

The practice of turning in green crops for manure is not of recent origin. Its benefits have been long known; but the clovers, buckwheat, and other large-seeded grasses, have generally been used for this purpose. But many other plants offer a cheaper substitute, since their seeds are smaller and less expensive, the only cost, indeed, being the expense of gathering.

14. Stipa. *Feather Grass.*

Spikelets one-flowered; flowers stipitate or borne on a slender stalk; glumes equal, membranaceous; pales longer than the glumes, thick, and leathery, the lower tipped with a very long awn, bent above, and twisted at the base; seed-scale rounded or cylindrical. Inflorescence in spreading panicles. Perennial, growing from one to two feet high.

Feather Grass (*Stipa pennata*) is one of the most beautiful of this genus. The awn of the floret is very long and feathery, rising from the summit of the outer palea, and often more than twenty times its length, and, with the exception of an inch at the base, which is twisted, soft and feathery through its whole length. The root is perennial and fibrous; the stem erect, round, smooth, hollow, from eighteen inches to two feet high; sheaths of the leaves roughish, and covering the joints. Stigmas feathery.

This grass is well known for its great beauty, and is cultivated in gardens, and gathered for vases and parlor ornaments. It grows wild in many parts of Germany, in dry, sandy soils.

Richardson's Feather (*Stipa Richardsonii*) is a spe-

cies growing wild in the vicinity of Sebago Lake, in Maine, and some other places. Glumes nearly equal, oblong; panicle loose, slender branches, awn of the palea twisted. Of no agricultural value.

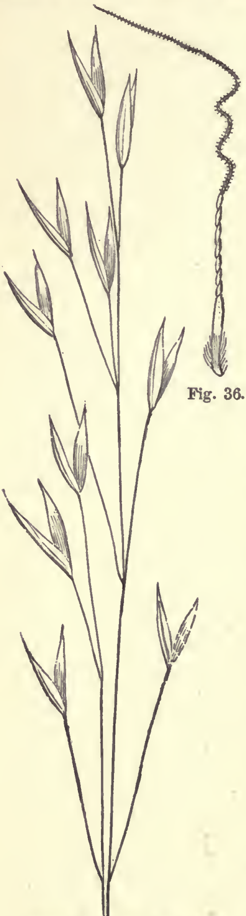

Fig. 36.

Fig. 35. Black Oat Grass.

BLACK OAT GRASS (*Stipa avenacea*) is sometimes met with in dry, sandy woods, but is of no agricultural value. It rises from one to two feet; its panicle is open, leaves almost bristle-form, palea blackish, nearly as long as the almost equal glumes; awn bent above, twisted below.

It is one of the prairie grasses of Michigan, Illinois, Wisconsin, &c., and is common at the South, flowering in June and July. Fig. 35 represents the panicle of this grass, with the naked glumes, while the upper palea and its bent and twisted awn is seen in Fig. 36.

PORCUPINE GRASS (*Stipa spartea*) has a shorter, contracted panicle, a stouter stem, rising from one to three feet high; glumes loose, greenish, slender, pointed, longer than the paleæ; awn strong and twisted, from three to six inches long, downy below, and rough above.

This is another prairie grass of Illinois, Iowa, and the north-westward, and is also a native of southern Europe and northern Africa. It is not a cultivated grass.

15. ARISTIDA. *Three-awned Grass.*

Flowers stipitate or on stalks; glumes unequal, often bristle-pointed; paleæ two, lower tipped with a triple awn, upper smaller, awnless; ovary smooth, scales two, smooth, entire; spikelets in simple or panicled racemes or spikes.

POVERTY GRASS (*Aristida dichotoma*) is known by its tufted stems or culms being much forked or branched, from five to fifteen inches high. Spikelets small, crowded in short, contracted racemes; side awns minute; middle no longer than the palea, bent downwards. Common in old, dry, sterile fields, especially at the South, and in Illinois and adjacent states.

THREE-AWNED GRASS (*Aristida ramosissima*). — Stems diffuse; spiked raceme loosely flowered; glumes three to five nerved, nearly equalling the flower; the awn bent back, an inch long. Found on dry prairies of Illinois, and in Kentucky.

SLENDER THREE-AWNED GRASS (*Aristida gracilis*) is also found in old, sandy fields, dry, sterile hill-sides and pine barrens, but is of no value for cultivation. Its stem is slender and erect, lateral awns as long as the palea. Never found except on the poorest soil.

DOWNY TRIPLE AWN (*Aristida stricta*). — Leaves straight, erect, rigid, downy; lower palea smooth; awns spreading, the middle one longest; glumes unequal, short, pointed. Perennial. Grows from two to three feet high, in rocky and shaded places, in Michigan, Illinois, Virginia, and southward. Of no value for cultivation.

PURPLE TRIPLE AWN (*Aristida purpurascens*) has rough, but less rigid leaves; lower palea rough, with slender lateral nerves; middle awn an inch long. Common from Massachusetts to Illinois and southward.

Prairie Triple Awn (*Aristida oligantha*) is a species found by Michaux on the prairies of Illinois, with a straight, erect stem, branching below; spikelets large, distant, solitary, alternate, short-pedicelled; glumes equalling the flower; awns long, the lateral a little shorter than the middle. Found also in Virginia and to the south-westward.

Long-awned Poverty Grass (*Aristida tuberculosa*). — Stem branched below, tumid at the joints; panicles loose, branching in pairs, one of which is short and two-flowered, the other longer and several-flowered; glumes longer than the palea, which is tipped with the common stalk of the three bent awns, twisting together at the base. It is found on sandy soils, from New England to Wisconsin. It is one of the prairie grasses of Illinois and southward.

16. Spartina. *Marsh Grass.*

Spikelets one-flowered, very flat, in two rows on the outer side of a triangular rachis; glumes compressed, keeled, pointed and rough, bristly on the keel; stamens three; styles long, united.

Fresh Water Cord Grass, or Tall Marsh Grass (*Spartina cynosuroides*). — This is found on the banks of streams and lakes, rising to the height of from two to four feet, with slender culm, narrow leaves, two to four feet long, tapering to a point, smooth except on the margins; spikes of a straw-color, five to fourteen in number, spreading, glumes awn-pointed. Found in Wisconsin, Illinois, Indiana, Ohio, Michigan, and Minnesota. Flowers in August.

The Salt Reed Grass (*Spartina polystachya*) has a stout culm, from four to nine feet high; broad leaves, roughish underneath and on the margins; spikes twenty

to fifty in number, forming a dense, oblong, purplish cluster. It is found on salt and brackish marshes, below high tide, especially southward.

RUSH SALT GRASS (*Spartina juncea*) grows from one to two feet high, stem slender, leaves narrow, rush-like, and very smooth. It is common on salt marshes and sandy sea-beaches, and flowers in August.

SALT MARSH GRASS (*Spartina stricta*) grows from one to three feet high, leafy to the top, and has from two to four spikes. Glumes pointed, very unequal. Salt marshes, Pennsylvania and South.

ROUGH MARSH GRASS (*Spartina glabra*), a variety of the last, is found commonly on the sea-coast from New England southward, with stem and leaves rather longer than the preceding, and spikelets from five to twelve, crowded.

SMOOTH MARSH GRASS (*Spartina alterniflora*), another variety of salt-marsh grass, with spikes more slender, three to five inches long. It has a strong and rancid odor, and is common with the last.

17. CTENIUM. *Toothache Grass.*

Glumes persistent, lower one smaller, upper concave below, with a stout awn bent like a horn on the back. Flowers four to six, all neutral but one. Stamens three.

TOOTHACHE GRASS (*Ctenium Americanum*) rises from three to four feet high, with a simple roughish stem; longer glume warty and awned. It is found in the wet pine barrens of New Jersey, but is of no agricultural value.

18. BOUTELOUA. *Gramma Grass.*

Spikes short, solitary, racemed; spikelets alternate, two to three flowered, the terminal flower imperfect.

Glumes two, keeled, the upper layer shorter than the flowers. Stamens three, anthers orange or red. Rachis extending beyond the spikelets.

MUSKIT, MESQUIT, or MEZQUITE GRASS (*Bouteloua oligostachya*), grows from six to twelve inches high, leaves narrow, spikes one to five; glumes and lower fertile palea slightly hairy, triple awned. Westward, Iowa and Minnesota.

BRISTLY MUSKIT (*Bouteloua hirsuta*) grows in tufts from eight to twenty inches high; leaves flat, lance-like, hairy; lower glume rough, with stiff hairs from dark warty glands; lower palea downy.

HAIRY MUSKIT (*Bouteloua curtipendula*) grows in tufts from perennial roots, one to three feet high; sheaths often hairy, leaves narrow, spikes thirty to sixty in number, flowers rough; the sterile are reduced to a single small awn, or to three awns shorter than the fertile flower.

Muskit or Mesquit grass is cultivated to considerable extent in some parts of the South, as in Louisiana, and has become a favorite grass in many sections. Very satisfactory experiments with it have also been made in Virginia.

19. GYMNOPOGON. *Beard Grass.*

Spikelets one-flowered, perfect, with a rudiment of a second; glumes awl-shaped, keeled, nearly equal; stamens three; stigmas purple, pencil-shaped; leaves short, flat, and thick.

NAKED BEARD GRASS (*Gymnopogon racemosus*) grows in clusters, wiry, leafy, spikes flower-bearing to the base; glumes pointed about half the length of the awn of the fertile flower. Common on the pine barrens of New Jersey, and at the South.

SHORT-LEAVED BEARD GRASS (*Gymnopogon brevifolius*). — Spikes on long stalks, flower-bearing only above the middle; lower palea short-awned; glumes pointed. Found in Delaware and southward.

20. CYNODON. *Bermuda Grass.*

Spikelets one-flowered, spikes usually digitate at the naked summit of the flowering stalks; glumes keeled, pointless; paleæ pointless and awnless, the lower and longer boat-shaped. Stamens three. Creeping perennials.

BERMUDA GRASS, SCUTCH GRASS (*Cynodon dactylon*). — Glumes very nearly equal; spikes four to five; pales smooth; stems smooth, hollow, prostrate at the base, with four or five leaves, flat or folded, acute, rigid, hairy, rough at the edges; lower joints covered by the sheaths; inflorescence digitate, purplish: stamens three; stigmas feathery. Penn. and southward.

This grass is distinguished from *Digitaria* in the spikelets, which are laterally compressed, and in rising singly from the rachis, and by wanting the ligule. In *Digitaria* the spikelets rise from the rachis in twos or threes, and the ligule is very distinct.

It grows abundantly on the West India Islands, and in the southern part of the United States, where it is esteemed as a very valuable grass.

21. DACTYLOCTENIUM. *Egyptian Grass.*

Spikelets several-flowered, crowded on one side of the flattened rachis, forming two to five close, comb-like spikes, digitate at the apex; glumes compressed and keeled, the upper one awned; stamens three.

EGYPTIAN GRASS (*Dactyloctenium Ægyptiacum*), the only species referred to this genus, is found in cultivated fields and yards in Virginia and southward. Stems diffuse, often creeping at the base; spikes four

or five, leaves hairy at the base. It is a troublesome annual weed, introduced from Europe. Found also in Illinois.

22. ELEUSINE. *Crop Grass.*

Spikelets two to six flowered, overlapping each other in close spikes on one side of a flattish rachis; spikes digitate, clustered; glumes awnless and pointless; stamens three; palea awnless and pointless.

CROP GRASS, CRAB GRASS, WIRE GRASS, CROW'S-FOOT (*Eleusine Indica*).—Stems ascending, flattened, branching at the base; spikes two to five, greenish.

This is an annual, and flowers through the season, growing from eight to fifteen inches high, and forming a fine green carpeting in lawns and yards. It is indigenous in Mississippi, Alabama, and adjoining states, and serves for hay, grazing, and turning under as a fertilizer. It grows there with such luxuriance, in many sections, as never to require sowing, and yields a good crop where many of the more northern grasses would fail.

23. LEPTOCHLOA. *Slender Grass.*

Spikelets three to many flowered, loosely spiked on one side of a long, thread-like rachis; glumes membranaceous, keeled, sometimes awl-pointed; lower palea three-nerved, and larger than the upper. Stamens two or three.

POINTED SLENDER GRASS (*Leptochloa mucronata*) is an annual, growing from two to three feet high, and flowering in August. Sheaths hairy; spikes from twenty to forty, two to four inches long, in a long panicle-like raceme; glumes pointed, about equalling the three or four awnless flowers. Found in fields from Virginia to Illinois, and southward.

CLUSTERING SLENDER GRASS (*Leptochloa fascicularis*).—Spikelets seven to eleven flowered, longer than the

glumes, smooth; leaves longer than the bent branching stems, which are from eight to fifteen inches long, the upper sheath forming the base of the panicle-like raceme; paleæ hairy, margined towards the base, the lower having two small lateral teeth, and an awn at the cleft of the apex.

Found in brackish marshes on the coast from Rhode Island southward, and from Illinois southward on the Mississippi River. Flowers in August.

24. Tricuspis.

Spikelets three to twelve flowered; glumes unequal; rachis of the spike bearded below each flower; lower palea much larger than the upper; convex, hairy on the back, three-nerved, and three-pointed by the projection of the nerves; stamens three; stigmas dark purple.

Tall Redtop (*Tricuspis seslerioides*) is a perennial, growing from three to five feet high, on dry and sandy fields, from New York to Illinois, and southward, flowering in August. It is a showy grass, with an upright, very smooth stem, smooth leaves, and large compound spreading panicle; spikelets very numerous; shining, purple flowers, hairy towards the base. It has sometimes been cut for hay, but is not considered of much value.

Sand Grass (*Tricuspis purpurea*) is also found on dry, sandy soils, along the coast, flowering in August and September. It is acid to the taste, grows from six inches to a foot high, in numerous stems, in a tuft from the same root, and has numerous bearded joints. Extends southward from Massachusetts to Virginia, and still further down the coast.

Horned Sand Grass (*Tricuspis cornuta*) is another species found at the South. Of no agricultural value.

25. Dupontia.

Spikelets two to four flowered; glumes nearly equalling the flowers, with a cluster of long hairs at the base of each flower. Paleæ thin, lower one entire, pointless; stamens three; perennial. Mostly arctic grasses.

Dupontia Grass (*Dupontia cooleyi*) is a tall grass, with roughish leaves; a large compound panicle; very unequal glumes; palea awnless. Found in Michigan, in the borders of a swamp in Washington, Macomb county. Of no agricultural value.

26. Diarrhena.

Spikelets two to ten flowered, in an open panicle; glumes much shorter than the flowers, the lower much smaller; lower palea egg-shaped, convex on the back, three-nerved above, sharp-pointed; stamens two. Grain large.

Twin Grass (*Diarrhena Americana*) grows from one and a half to three feet high, along the shaded banks of rivers and woods, from Ohio and Illinois southwards. Flowering in August.

27. Dactylis. *Cock's-foot.*

Spikelets several-flowered, crowded in clusters, one-sided; panicle dense at the top, branching; glumes two; herbaceous, keeled; awn pointed; stamens three; seed oblong, acute, free. Named from *dactylus*, a finger.

Orchard Grass, Rough Cock's-foot (*Dactylis glomerata*), flowers in dense clusters. Its stem is erect, about three feet high. I have found specimens, in good soil, over five feet high. Leaves linear, flat, dark-green, rough on both surfaces, which, with the fancied resemblance of its clusters to the foot of a barn-yard fowl, have given it the common name in England of rough

cock's-foot. Root perennial. Flowers in June and July. Not uncommon in fields and pastures. It is shown in Fig. 37, and a magnified spikelet in Fig. 38.

Fig. 38.

Fig. 37. Orchard Grass.

This is one of the most valuable and widely-known of all the pasture grasses. It is common to every country in Europe, to the north of Africa, and to Asia, as well as to America. Its culture was introduced into England from Virginia, where it had been cultivated some years previously, in 1764. It forms one of the most common grasses of English natural pastures, on rich, deep, moist soils. It became, soon after its introduction into England, an object of special agricultural interest among cattle feeders, having been found to be exceedingly palatable to stock of all kinds. Its rapidity of growth, the luxuriance of its aftermath, and its power of enduring the cropping of cattle, commend it highly to the farmer's care, especially as a pasture grass.

As it blossoms earlier than Timothy, and about the time of red clover, it makes an admirable mixture with that plant, to cut in the blossom and cure for hay. As a pasture grass it should be fed close, both to prevent its forming thick tufts and to prevent its running to seed, when it loses a large proportion of its nutritive matter, and becomes hard and wiry. All kinds of stock eat it greedily when green.

Judge Buel said of it, "I should prefer it to almost every other grass, and cows are very fond of it." Elsewhere he says: "The American Cock's-foot, or Orchard Grass, is one of the most abiding grasses we have. It is probably better adapted than any other grass to sow with clover and other seeds for permanent pasture or for hay, as it is fit to cut with clover, and grows remarkably quick when cropped by cattle. Five or six days' growth in summer suffices to give a good bite. Its good properties consist in its early and rapid growth, and its resistance of drouth; but all agree that it should be closely cropped. Sheep will pass over every other grass to feed upon it. If suffered to grow

long without being cropped, it becomes coarse and harsh. Colonel Powell (a late eminent farmer of Pennsylvania), after growing it ten years, declares that it produces more pasturage than any other grass he has seen in America. On being fed very close, it has produced good pasture after remaining five days at rest. It is suited to all arable soils. Two bushels of seed are requisite for an acre when sown alone, or half this quantity when sown with clover. The seed is very light, weighing not more than twelve or fourteen pounds to the bushel. It should be cut early for hay."

Mr. Sanders, a well-known practical farmer and cattle breeder, of Kentucky, says of it: "My observation and experience have induced me to rely mainly on orchard grass and red clover; indeed, I now sow no other sort of grass-seed. These grasses, mixed, make the best hay of all the grasses for this climate (Kentucky). It is nutritious, and well adapted as food for stock. Orchard grass is ready for grazing in the spring ten or twelve days sooner than any other that affords a full bite. When grazed down and the stock turned off, it will be ready for re-grazing in less than half the time required for Kentucky blue grass. It stands a severe drought better than any other grass, keeping green and growing when other sorts are dried up. In summer it will grow more in a day than blue grass will in a week. Orchard grass is naturally disposed to form and grow in tussocks. The best preventive is a good preparation of the ground, and a sufficiency of seed uniformly sown. The late Judge Peters, of Pennsylvania, — who was at the head of agricultural improvement in that state for many years, — preferred it to all other grasses."

Orchard grass is less exhausting to the soil than rye grass or Timothy. It will endure considerable shade. In a porous subsoil its fibrous roots extend to a great

depth. Its habit of growth unfits it for a lawn grass. Its seed weighs twelve pounds to the bushel, and, to sow alone, about twenty-four pounds to the acre are required to make sure of a good crop. It should not be sown alone except for the sake of raising the seed. It is worthy of a much more extended cultivation among us.

28. Kœleria.

Spikelets crowded in a dense, spike-like panicle, three to seven flowered. Glumes and lower palea compressed, keeled; stamens three; grain free.

Crested Kœleria (*Kœleria cristata*) is a perennial grass from two to two and a half feet high, and somewhat common on dry, gravelly places from Pennsylvania to Illinois and westward. Panicle narrowly spiked; lower palea pointed; leaves flat, the lower ones somewhat hairy.

Truncated Kœleria (*Kœleria truncata*) has a dense and contracted panicle, with the spikelets crowded on the short branches; upper glume truncate, obtuse, rough on the back. Perennial; growing from two to three feet high, and flowering in June, on dry soils from Pennsylvania to Wisconsin, and southward.

29. Eatonia.

Glumes nearly equal, but dissimilar, and shorter than the flowers; the lower one-nerved, keeled; the upper three-nerved on the back, not keeled. Lower palea oblong, compressed, boat-shaped; stamens three.

Pennsylvanian Eatonia (*Eatonia Pennsylvanica*) is a common grass in moist woods and meadows, in the Eastern, Middle, and Western States; growing about two feet high, perennial, and flowering in June and

July. Its panicle is long and loose; leaves short and flat, and of a pale-green color.

30. MELICA. *Melic Grass.*

Spikelets from two to five flowered; one, and sometimes two or three of the upper flowers imperfect and dissimilar, wrapped around each other. Glumes usually large, convex, obtuse; stamens three.

MELIC GRASS (*Melica mutica*) is a grass natural to the rich soils of the Western States, Ohio, Illinois, and Wisconsin, and grows with a loose, smooth, simple panicle, from two to four feet high; glumes unequal; two fertile flowers. It is perennial, and flowers in June.

31. GLYCERIA. *Manna Grass.*

Spikelets rounded; rachis separating into joints; glumes two, pointless, nearly equal; paleæ awnless, the lower rounded on the back; five to seven nerved; stamens three; root creeping, perennial. *Glyceria* from a Greek word, signifying sweet, from the taste of the grain.

RATTLESNAKE GRASS (*Glyceria Canadensis*) has an oblong, pyramidal, spreading panicle, with beautifully drooping spikelets, six or eight flowered, and long, roughish leaves, which together make it an object of interest and search for bouquets and vases; resembling the quaking grass in general appearance. It is very common in wet, boggy places, growing from two to three feet high, but possesses little or no agricultural value. Found common in New England and the Western States, in soils suitable to its growth. Flowers in July.

The OBTUSE SPEAR GRASS (*Glyceria obtusa*) has a dense, narrowly oblong panicle; spikelets six or seven flowered, erect, swelling; lower palea obtuse, leaves

Fig. 40. Fig. 41. Fig. 42. Fig 39. Meadow Spear Grass.

smooth, as long as the stem. This is an aquatic grass, found occasionally on the borders of ponds from New England to Pennsylvania, near the coast. Flowers in August. Of no agricultural value.

Long Panicled Manna Grass (*Glyceria elongata*) is a very distinct species; stems one to three feet high; panicle branching, narrowly elongated, recurving; the branches appressed; spikelets pale, erect, three to four flowered; lower palea obtuse, rather longer than the upper; stamens two, stigmas compound, leaves very long and rough. Flourishes in wet woods and swamps from New England to Michigan, and northward. Flowers in June and July; perennial. Of no special agricultural value.

Meadow Spear Grass, Nerved Manna Grass (*Glyceria nervata*), is the fowl meadow of many farmers, while the grass commonly called fowl meadow by others (*Poa serotina*) often goes with them under the name of bastard fowl meadow. It has a broad, open panicle, often six inches in length, with slender branches; spikelets small, ovate, oblong, green; leaves in two rows like a fan, a little rough; stem a little compressed, one to three feet high.

It is a native American grass, the nutritive value of which, according to Sinclair, is equal at the time of flowering and when the seed is ripe, while the nutritive matter of the lattermath is said to be greater than that of most other grasses. It is a hardy grass, grows best on moist ground, but it is said also to succeed on lightish upland soils. It is a very valuable native grass, retaining its nutritive qualities until the seed is ripe, and then sending up large, fan-like shoots, which are succulent and nutritious. It would be a valuable ingredient in a mixture for wet or moist pastures. Common. It is seen in Fig.

39, while in Fig. 40 are seen its root stalks. A magnified spikelet is shown in Fig. 41, and the calyx in Fig. 42.

Fig. 43. Water Spear Grass. Fig. 44.

The PALE MANNA GRASS (*Glyceria pallida*) grows mostly in shallow water, and is very common. Panicle

erect, with hairy branches, spreading, rough; spikelets few, linear, oblong, five to nine flowered; lower palea oblong, minutely *five-toothed;* leaves short, sharp-pointed, and pale-green. Flowers in July. Culms one to three feet long, creeping at the base.

Pale manna grass is of no value for cultivation, since, from the place of its growth, it could hardly be used to advantage, like many other grasses which are now worthless, for turning in green as a manure. The rank, leafy grasses, many of which are regarded as weeds, would be more suitable for the purpose.

The Water Spear Grass, or Reed Meadow Grass (*Glyceria aquatica*), grows in wet soils and the shallow water of marshes. It is a tall, reedy grass, four or five feet high, with a panicle nearly a foot long, diffuse, with smooth, flexuous branches. Shown in Fig. 43. From its large size and broad leaves it can hardly be mistaken for any of the other species of this genus, or of any of the genus *Poa*, to which it is referred by Linnæus and others. Its root is perennial, creeping; stem erect, stout, smooth; joints seven, smooth; spikelets numerous. Florets not webbed. Flowers in August.

This grass has been cultivated to some extent in England and France for its large yield of coarse hay; and, if cut while green and before attaining its full growth, it is said to make a nutritious and palatable fodder, cattle being fond of it. Its spikelet is seen magnified in Fig. 44.

It is worthy of trial on wet meadows, as it would certainly be more valuable than the coarse sedges often found there. It is common North and West.

The Floating Meadow Grass, or Common Manna Grass (*Glyceria fluitans*), differs from the other species of this genus in the general appearance of its slender

panicle, and long, linear spikelets. It grows from fifteen inches to two feet high, with a perennial, creeping root, erect, round, smooth stem, leaves large, rather long, roughish on both sides, lower ones flat, upper ones generally folded; spikelets few, long and linear, as shown in Fig. 45, which represents the plant near the time of flowering. Fig. 46 shows a magnified spikelet of this grass. Flowers late in June.

Fig. 45. Floating Meadow Grass.

Fig. 46.

It grows naturally in very moist and muddy places, in ditches, on the margins of ponds and streams, and is very common, especially northward and westward. It is capable of cultivation as a permanent moist pasture grass, and its yield compares well with many of the other grasses. Its seeds are greedily sought by birds, and in some parts of Germany are said to be used as a delicacy in soups and gruels. It has sometimes been cultivated in France and other parts of Europe, along alluvial borders of streams and lakes, and is found to produce a sweet and nutritious grass. The

seed has sometimes been ground into meal, or flour. It would doubtless be valuable to sow for green manuring.

POINTED SPEAR GRASS (*Glyceria acutiflora*) is less common than the preceding species. It is found in wet places from New England to Pennsylvania, resembling the floating manna grass, but with smaller leaves, and flowers twice the length, and less nerved.

GOOSE GRASS, CREEPING SEA MEADOW GRASS, SEA SPEAR GRASS (*Glyceria maritima*), Fig. 47, is a beautiful grass, which appears in and around salt marshes, growing from six to twelve inches high, and having a perennial, *creeping* root. Stem erect, round, smooth; leaves mostly folded and compressed, roughish on the inner surface ; spikelets linear, with from six to ten florets, *not* webbed, the outer palea or lower floret terminating in an acute point. The flower is seen in Fig. 48. Flowers in July. Grows naturally near the sea. This is one of the most valuable of the salt-marsh grasses, being exceedingly relished by stock of all kinds. It is generally considered best when it grows in mixture with other species of plants, as the black grass (*Juncus bulbosus*), for instance, and deserves a passing notice.

It is very well known that large tracts of salt

Fig. 47. Goose Grass.

Fig. 48.

marsh are nearly barren. Sometimes close cutting in the early morning, while the dew is on the grass and when it cuts comparatively easy, kills it out, and from that cause the marsh becomes barren. More often, however, excess of water, either upon the surface or in the soil, from the proximity of ponds which have no outlet, causes barrenness. On all such tracts goose grass springs up and dots the whole surface with circular patches of green, which in shape are very like ringworms on the human skin.

This valuable grass is seldom found alone except on these barren tracts, and upon them it grows so short and thin as seldom to be worth cutting. One will therefore never see any goose-grass hay except mixed with other kinds, and generally with black grass.

When these tracts begin to improve, from draining or from any other cause, other grasses make their appearance, and the goose grass grows much more vigorous, and becomes valuable. This will continue to be the case for several years, until the roots of the other grasses have taken entire possession of the soil, when the goose grass disappears almost entirely, and bides its time, ready to appear again whenever from any cause its intrusive competitors cease to exist.

The hay made from the mixture of goose, and other grasses — among which black grass generally predominates — is a most valuable fodder. The goose grass is so weighty that it takes but a small quantity, comparatively, for a ton, and cattle eat it with almost as much avidity as oats, or any other grain. In fact, no hay is more valuable than black grass with a large admixture of goose grass, when properly cured. This is the result of the experience of practical farmers along the coast.

The curing process requires care and time; for goose grass is as full of juice as possible, and requires a much longer exposure than black grass, while a very little

wet, when it is partially cured, materially injures the black grass.

We may judge of the properties of goose grass from the fact that in several instances within my own knowledge cattle have died of hoove from eating it early in the spring, as is not unfrequently the case with clover.

It resembles in the shape of its leaves, and somewhat in its cluster-like growth, that species of garlic which used formerly to be grown in kitchen gardens, called *cives,* or more properly *chives.* Its seed-stalks and seeds are almost precisely like the spikelets and seeds of the common plantain.

It grows both on high and low marshes, but is very seldom worth cutting on those tracts where it grows by itself, and without the admixture of other grasses.

It is proper to state, in this connection, that experiments have been made to introduce this valuable grass into our fresh wet meadows, and with good success.

Most of the superior salt-marsh grasses are greatly improved by ditching, while the poorer and comparatively worthless plants found there very soon die out after this operation, and give place to more valuable species. It may be safely asserted that, on an average, the value of the marsh is nearly doubled by it, while the vegetable, peaty matter taken from it is sufficient, if properly used, to pay a considerable portion of the outlay.

Clustered Spear or Reflexed Meadow Grass (*Glyceria distans*) is found also in salt marshes along the coast. It appears to be closely allied to goose grass. Stems ascending, destitute of running shoots ; branches of the panicle three to five in a half whorl, and spreading. Leaves flat. It is of less value than the preceding species.

32. Brizopyrum. *Spike Grass.*

Large flowers and spikelets, compressed and crowded in a dense spiked panicle. Leaves crowded on the stems, folded, and mostly rigid.

Spike Grass (*Brizopyrum spicatum*) is a salt-marsh grass, with culms or stems in tufts from creeping root-stalks, from ten to eighteen inches high. Flowers in August.

33. Poa. *Spear Grasses.*

Spikelets ovate, compressed, flowers two to ten in an open panicle; glumes shorter than the flowers; lower palea compressed, keeled, pointless, five-nerved; stamens two or three, seed oblong, free; stems tufted; leaves smooth, flat, and soft.

Annual Spear Grass (*Poa annua*), Fig. 1, is, perhaps, the most common of all our grasses. Its stems are spreading, flattened, panicle often one-sided, spikelets crowded, three to seven flowered; lower palea more or less hairy on the nerves below; leaves of a light green, sword-shaped, flat, often *crumpled at the margins*, as appears in the figure, smooth on both surfaces, rough at the edges. *Florets not webbed*, and this distinguishes it from the June grass (*Poa pratensis*) and its varieties. The outer or lower palea of this grass has no hairs on the lateral ribs, as the *poa pratensis* has. This modest and beautiful grass flowers throughout the whole summer, and forms a very large part of the sward of New England pastures, producing an early and sweet feed, exceedingly relished by cattle. It does not resist the drought very well, but becomes parched up.

The Wavy Meadow Grass (*Poa laxa*) occurs rarely, on high and rocky hills in New England, New York, and northern latitudes. Of no agricultural value.

Short-leaved Spear Grass (*Poa brevifolia*) is found in rocky and hilly woodlands of the Middle and Southern States. The upper leaves very short, the root-leaves long, nearly equalling the stem.

Southern Spear Grass (*Poa flexuosa*) is found in the dry woods of Virginia, Kentucky, and other Southern States. Panicle very diffuse, leaves taper pointed; lower palea prominently nerved; stem slender. Of no agricultural value.

Wood Spear Grass (*Poa alsodes*) is found in woods and hill-sides from New England to Wisconsin. Leaves narrow, acute, the upper often sheathing the base of the panicle, the hairy branches of which are generally in threes and fours.

Weak Meadow Grass (*Poa debilis*), another species in rocky woodlands, from New England to Wisconsin. Flowers in May. Panicle small, its branches slender, in pairs and threes. Stem weak.

Sylvan Spear Grass (*Poa sylvestris*) has an erect flat stem, a short pyramidal panicle, with branches, in fives or more. Found in rocky woods and meadows in Ohio, Wisconsin, and the South.

Fowl Meadow, False Redtop (*Poa serotina*).—Fig. 49. Spikelets two to four, sometimes five flowered; ligules oval, spear-shaped; flowers green, often tinged with purple; roots slightly creeping; wet meadows and banks of streams, very common. Flowers in July and August. In long-continued moist weather the lower joints send up flowering stems. The panicle is erect and spreading when in flower, but more contracted and drooping when ripe. Indigenous to many parts of this country, and also a native of Europe. Its spikelet is seen magnified in Fig. 50; its flower, in Fig. 51; its germ, in Fig. 52, and its seed in Fig. 53.

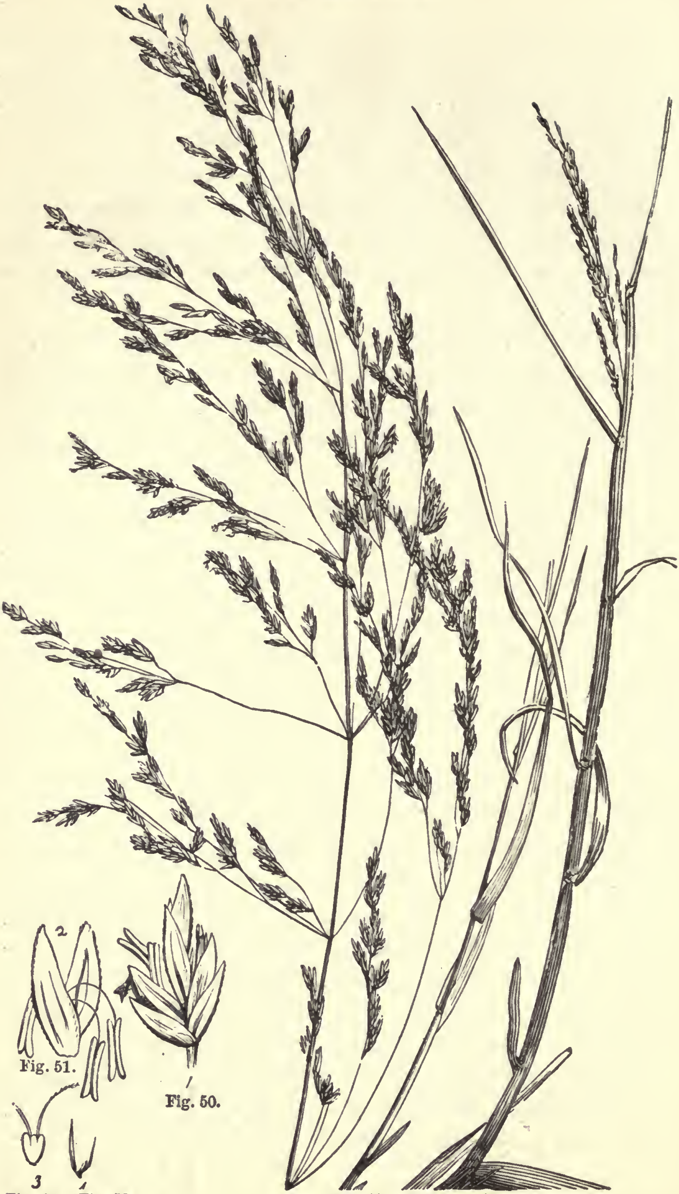

Fig. 51. Fig. 50.

Fig. 52. Fig. 53. Fig. 49. Fowl Meadow.

It early commended itself to the attention of farmers, for Jared Eliot, writing in 1749, says of it: "There are two sorts of grass which are natives of the country, which I would recommend, — these are Herd's grass (known in Pennsylvania by the name of Timothy grass), the other is Fowl Meadow, sometimes called Duck grass, and sometimes *Swamp-wire grass.* It is said that Herd's grass was first found in a swamp in Piscataqua, by one Herd, who propagated the same; that fowl meadow grass was brought into a poor piece of meadow in Dedham, by ducks and other wild water-fowl, and therefore called by such an odd name. It is supposed to be brought into the meadows at Hartford by the annual floods, and called there Swamp-wire grass. Of these two sorts of natural grass, the fowl grass is much the best; it grows tall and thick, makes a more soft and pliable hay than Herd's grass, and consequently will be more fit for pressing, in order to ship off with our horses; besides, it is a good grass, not in abundance inferior to English grass. It yields a good burden, three loads to the acre. It must be sowed in low, moist land. This grass has another good quality, which renders it very valuable in a country where help is so much wanting; it will not spoil or suffer, although it stand beyond the common times for mowing. Clover will be lost, in a great measure, if it be not cut in the proper season. Spear grass, commonly called English grass, if it stands too long, will be little better than rye straw; if this outstand the time, it is best to let it stand till there comes up a second growth, and then it will do tolerably well; but this fowl grass may be mowed any time from July to October. * * * This I wondered at, but, viewing some of it attentively, I think I have found the reason of it. When it is grown about three feet high, it then falls down, but doth not rot like other

grass when lodged; in a little time after it is thus fallen down, at every joint it puts forth a new branch. Now, to maintain this young brood of suckers there must be a plentiful course of sap conveyed up through the main stem or straw; by this means the grass is kept green and fit for mowing all this long period."

It grows abundantly in almost every part of New England, especially where it has been introduced and cultivated in suitable ground, such as the borders of rivers and intervals occasionally overflowed. It will not endure to be long covered with water, especially in warm weather. It is well to let a piece go to seed, save the seed, and scatter it over low lands. It makes an excellent grass for oxen, cows, and sheep, but is thought to be rather fine for horses. It never grows so coarse or hard but that the stalk is sweet and tender, and eaten without waste. It is easily made into hay, and is a nutritive and valuable grass. Owing to its constantly sending forth flowering stems, the grass of the lattermath contains more nutritive matter than the first crop at the time of flowering; hence the names *fertilis* and *serotina*, fertile and late flowering meadow grass. It thrives best when mixed with other grasses, and deserves a place in all mixtures for rich, moist pastures.

WOOD MEADOW GRASS (*Poa nemoralis*) grows from eighteen inches to two feet high; has a perennial, creeping root, an erect stem, slender and smooth; the upper sheath no longer than its leaf, with a very short ligule, the base of the floret having a silky web suspending the calyx; leaves light-green. Fig. 54. It is common in moist, shady places, and appears as a tall, rank grass, with a long, finely-arched panicle. It flowers in June, and ripens its seed in July. A magnified flower is seen in Fig. 55.

Fig. 54. Wood Meadow Grass.

Fig. 55.

Though it has never, to my knowledge, been cultivated in this country, it appears to me worthy of attention for moist soils. It is certainly to be classed among the good-shaded pasture grasses, furnishing a fine, succulent, and very nutritive herbage, which cattle are very fond of.

THE ROUGH-STALKED MEADOW GRASS (*Poa trivialis*), though not so common as the June grass (*Poa pratensis*), is still often met with, and is found to have webbed florets; outer palea five-ribbed, marginal ribs not hairy, ligule long and pointed, stems two to three feet high. Distinguished from June grass by having rough sheaths, while in the latter the sheaths are smooth, the ligule obtuse, and the marginal ribs of outer palea furnished with hairs. It differs from June grass also in several other respects. The rough-stalked meadow grass has a fibrous root, that of the

June grass is creeping. It flourishes in moist meadows, where it flowers in July. Introduced.

Fig. 56. Rough-stalked Meadow Grass. Fig. 57.

This grass is seen in Fig. 56, while Fig. 57 represents a flower somewhat magnified.

It is a valuable grass to cultivate in moist, sheltered soils, possessing very considerable nutritive qualities, coming to perfection at a desirable time, and being exceedingly relished by cattle, horses, and sheep. For suitable soils it should form a portion of seed sown, producing, in mixture with other grasses, which serve to shelter it, a large yield of hay, above the average of grass usually grown on a similar soil. Seven pounds of seed to the acre will produce a good sward. The grass is said to lose about seventy per cent. of its weight in drying. Its hay contains about one and sixty hundredths per cent. of azote, and the nutritive qualities of the lattermath are said to exceed very considerably those of the crop cut in the flower or in the seed.

GREEN MEADOW GRASS, JUNE GRASS, COMMON SPEAR GRASS, KENTUCKY BLUE GRASS, &c. (*Poa pratensis*). — Lower florets connected at the base by a web of long, silky filaments, holding the calyx; outer palea five-ribbed, marginal ribs hairy; upper sheath longer than its leaf; height from ten to fifteen inches; root perennial, *creeping;* stem erect, smooth and round; leaves linear, flat, acute, roughish on the edges and inner surface; panicle diffuse, spreading, erect. The plant is of a light-green color, the spikelets frequently variegated with brownish purple. Introduced, and probably indigenous to some parts of the country. Flowers in June. Fig. 58 represents this grass, and Fig. 59 a flower magnified.

This is an early grass, very common in the soils of New England and the West, in pastures and fields, constituting a considerable portion of the turf. It varies very much in size and appearance, according to the soil on which it grows. In Kentucky it is universally

known as Blue Grass, and elsewhere frequently as Kentucky Blue Grass, and still more frequently, in the

Fig. 59.

Fig. 58. June Grass.

Eastern States, as June Grass. It has been called by some, without much reason, the most valuable of all the grasses in our pastures. It comes into the soil in some parts of the country when left to itself, and grows luxuriantly and is relished by cattle. Its creeping root is said by some to impoverish the soil. Wherever it is intended for hay it is cut at the time of flowering, as, if the seed is allowed to ripen, more than a fourth part of the crop, according to some, is lost. In its earliness it is equalled by some of the other grasses, and in its nutritive constituents it is surpassed, according to the recent and reliable investigations of Prof. Way, by several other species. After being cut in summer it starts up slowly. Low says, "It is inferior to the rough-stalked meadow grass, and it may be questioned whether it deserves to be reckoned among the superior pasture grasses."

It produces but one flowering stem in a year, while many of the other grasses continue to shoot up flower-stalks and run to seed through the season. On this account it is recommended highly for lawns, where uniformity is desired. The produce ordinarily is small, compared with other grasses, but the herbage is fine. It grows well in rather a dry soil, but will grow on a variety of soils, from the dryest knolls to a wet meadow, but does not withstand our severe droughts as well as some other grasses. Its reputation is higher in this country than in England, where it is denied, by many farmers, even a place among the grasses to be recommended for cultivation. It endures the frosts of winter better than many other grasses; and in Kentucky, where it attains the highest perfection as a pasture grass, it sometimes continues luxuriant through their mild winters.

June grass requires at least two or three years to

become well set, and it does not arrive at its perfection as a pasture grass till the sward is older than that; and hence it is not suited to alternate husbandry, or where the land is to remain in grass only two or three years, and then be ploughed up.

In Kentucky, the best blue grass is found in partially shaded pastures. A well-known farmer of that state, in a communication to the *Ohio Farmer*, says: "In our climate and soil, it is not only the most beautiful of grasses, but the most valuable of crops. It is the first deciduous plant which puts forth its leaves here; ripens its seed about the tenth of June, and then remains green, if the summer is favorable in moisture, during the summer months, growing slowly till about the last of August, when it takes a second vigorous growth, until the ground is frozen by winter's cold. If the summer is dry, it dries up utterly, and will burn if set on fire; but even then, if the spring growth has been left upon the ground, is very nutritious to all grazing stock, and especially to sheep and cattle, and all ruminating animals. When left to have all its fall growth, it makes fine winter pasture for all kinds of grazing animals. Cattle will not seek it through the snow, but sheep, mules, and horses, will paw off the snow and get plenty without any other food. When covered with snow, cattle require some other feeding; otherwise they do well all winter upon it.

"It makes also the best of hay. I have used it for that for twenty years. It should be cut just as the seeds *begin* to ripen, be well spread, and protected from the dew at night by windrowing or cocking; the second evening stacked, with salt, or sheltered with salt also. When properly cured, stock seem greatly to prefer it to all other hay. I would not recommend it for meadow, especially, however, because the yield is

hardly equal to Timothy and clover, and because it is more difficult to cut and cure."

The same writer says: "Any time in the winter, when the snow is on the ground, sow broadcast from three to four quarts of clean seed to the acre. With the spring the seeds germinate, and are very fine in the sprouts, and delicate. No stock should be allowed for the first year, nor until the grass seeds in June, for the first time in the second year. The best plan is to turn on your stock when the seed ripens in June. Graze off the grass, then allow the fall growth and graze all winter, taking care never to feed the grass closely at any time."

Another eminent cattle breeder, speaking of this grass, says, "Whoever has limestone land has blue grass; whoever has blue grass has the basis of all agricultural prosperity; and that man, if he have not the finest horses, cattle, and sheep, has no one to blame but himself. Others, in other circumstances, may do well. He can hardly avoid doing well, if he will try."

By reference to a table on a subsequent page, containing the results of the recent investigations of Prof. Way, the distinguished chemist of the Royal Agricultural Society of England, will be seen the relative value of this grass when green, as compared with Timothy, for instance, as shown in the nutritive and flesh-forming, and especially in the fat-forming principles, which contribute so largely to the development and support of the whole animal system. The reader is referred to that table, and to another following it, containing analyses of these plants when dried and freed from water, and to the explanatory remarks on the nutritive principles of plants, which precede those tables.

Blue Grass, or Wire Grass (*Poa compressa*). — Stems ascending, flattened, the uppermost joint near

the middle; leaves short, bluish-green; panicle dense and contracted, expanding more at flowering; short branches often in pairs, covered with four to nine flowered, flat spikelets; flowers rather obtuse, linear, hairy below on the keel; ligule short and blunt; height about a foot. It is very common on dry, sandy, thin soils and banks, so hardy as to grow on the thin, hard soils covering the surface of rocks, along trodden walks, or gravelly knolls.

Blue grass shoots its leaves early, but the amount of its foliage is not large; otherwise it would be one of our most valuable grasses, since it possesses a large per cent. of nutritive matter. Flowers in July. Most grazing animals eat it greedily; cows feeding on it produce a very rich milk and fine-flavored butter, and it is especially relished by sheep. Its bluish-green stems retain their color after the seed is ripe. It shrinks less in drying than most other grasses, and consequently makes a hay very heavy in proportion to its bulk. It is an exceedingly valuable pasture grass on dry, rocky knolls, and should form a portion of a mixture for such soils. This should not be confounded with Kentucky blue grass, alluded to above.

34. Eragrostis.

Spikelets two to seventy flowered; lower pale three-nerved, not hairy at the base, like *Poa*, the upper remaining on the entire rachis after the rest of the flowers have fallen off. Stems often branching.

Creeping Meadow Grass (*Eragrostis reptans*), Fig. 60, is often found on the gravelly banks of rivers, from New England to the Western States. It grows from six to fifteen inches high, is annual, and flowers in August. It is a delicate and beautiful grass, with short, nearly awl-shaped leaves, smooth, long spikelets, loose sheaths,

slightly hairy on the margin; panicles from one to two inches long. Its panicle and creeping root-stalk are seen in Fig. 60. Its spikelets magnified, in Fig. 61. A palea in Fig. 62, its stamens in Fig. 63, and a seed in Fig. 64, while a magnified surface of a rootlet is shown in Fig. 65.

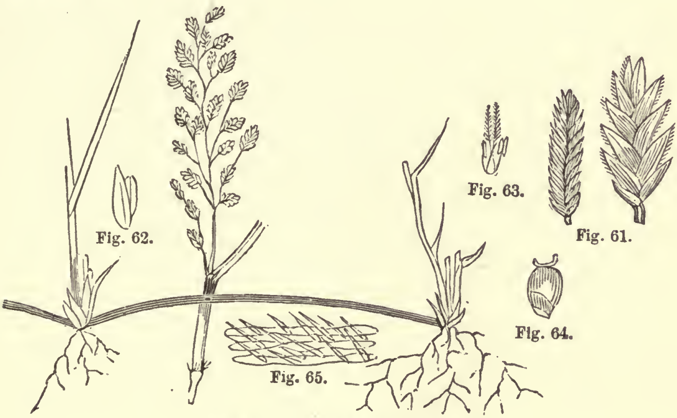

Fig. 60. Creeping Meadow Grass.

The STRONG-SCENTED MEADOW GRASS (*Eragrostis poœoides*) is sometimes found in sandy fields, roadsides, cultivated grounds, and waste places. Its leaves are flat and smooth; lower sheaths hairy, spikelets containing from ten to twenty florets, of a lead-color. It flowers in August and September.

The PUNGENT MEADOW GRASS.—A variety of the last (*Eragrostis poœoides*, var. *megastachya*) is found more frequently on similar situations; flowering about the same time; emitting, when fresh, a sharp and disagreeable odor, by which it may be known.

The SLENDER MEADOW GRASS (*Eragrostis pilosa*) is found with a large, loose, pyramidal panicle; spikelets from five to twelve flowered, of a purplish lead-color;

glumes and lower pale obtuse; on sandy and gravelly waste places, from New England to Illinois, and southward. It is from six to twelve inches high.

SHORT-STALKED MEADOW (*Eragrostis Frankii*), a grass found in low sandy ground in Ohio, Illinois, and southwestward; has a dense spreading panicle; spikelets from two to five flowered, on slender pedicels; glumes acute; lower pale egg-shaped, acute. Grows from three to eight inches high.

SOUTHERN ERAGROSTIS (*Eragrostis Purshii*) grows with a lengthened panicle, widely spreading, and very loose; on sandy and sterile lands, from New Jersey to Virginia, and southward. Spikelets shorter than their hairy pedicels; glumes and lower pale acute. Flowers in August.

BRANCHING SPEAR GRASS (*Eragrostis tenuis*) is another species, found from Illinois to Virginia, and at the South, on soils similar to the last, with a panicle from one to two feet long, and very loose. Glumes awl-shaped, very acute; lower pale three-nerved; leaves from one to two feet long. Flowers from August to October.

HAIR-PANICLED MEADOW GRASS (*Eragrostis capillaris*), with its expanding, loose, and delicate panicle, from one to two feet long, is found in sandy, waste places, and very common southward. Spikelets small, two to four flowered, and greenish or purplish; leaves and sheaths hairy. Flowers in August and September.

MEADOW COMB GRASS (*Eragrostis pectinacea*) is found also from New England southward, near the coast, and from Michigan and Illinois southward. Panicle widely diffuse; spikelets flat, five to fifteen flowered, purple; glumes and flowers acutish; lower pale three-nerved; leaves rigid, long, and hairy.

A variety of this species, the *Eragrostis spectabilis*, is found also on similar soils and situations.

Fig. 66. Quaking Grass.

Fig. 67.

35. Briza. *Quaking Grass.*

Glumes roundish, unequal, of a purple color. Spikelets many-flowered, heart-shaped; lower pale roundish and entire; upper smaller, egg-shaped, flat; leaves flat, stamens three.

Quaking Grass (*Briza media*) is sometimes met with in the pastures of Massachusetts and in Pennsylvania. Panicle erect, with very slender, spreading branches, and large, purplish, tremulous spikelets, from five to nine flowered; inner glume finely fringed, entire at the end. It is shown in Fig. 66. In Fig. 67 is shown a magnified spikelet.

It is a very beautiful, light, slender grass, about a foot high, perennial. Flowering in June and July. There is an annual, the Large Quaking Grass (*Briza maxima*), with large, many-flowered spikes, cultivated in gardens for ornament, and gathered for vases as an interesting curiosity.

36. Festuca. *Fescue Grasses.*

The characters of this genus are oblong spikelets, somewhat compressed, from three to many flowered; two very unequal glumes, pointed; paleæ roundish on the back; from three to five nerved; awn pointed or bristle-shaped; stamens three; flowers harsh, often purplish; panicle nearly erect; leaves narrow, rigid, of a grayish green.

Small Fescue Grass (*Festuca tenella*). — The small fescue has a spike-like panicle, somewhat one-sided, from seven to nine flowered; awn of the awl-shaped palea slender; leaves bristle-formed; stem slender, six to twelve inches high. It flourishes on dry and sterile soils, and is common from New England to Illinois and Wisconsin. Flowers in July.

Sheep's Fescue (*Festuca ovina*), Fig. 68, is known by its narrow panicle; short, tufted, bristle-shaped leaves, of a grayish color, somewhat tinged with red; its spikelets two to six flowered; awn often nearly wanting. Its flower is shown magnified in Fig. 69.

It grows from six to ten inches high, in dense, perennial-rooted tufts, forming an excellent pasturage for sheep. It flowers in June and July, in the dry pastures of New England, westward to Lake Superior, and northward.

Hard Fescue Grass (*Festuca duriuscula*) is also found to some extent, though not so commonly as the small fescue. It is by some regarded as a variety of the sheep's fescue, taller, and with a panicle more open, leaves flat, and spikelets four to eight flowered. It grows from one to two feet high. Flowers in June, in pastures and waste grounds.

Fig. 68. Sheep's Fescue.

Fig. 69.

The Red Fescue (*Festuca rubra*), by some regarded as only a variety of the preceding, is one of the largest of

the varieties of fescue. Its leaves are broadish, flat; root extensively creeping, and throwing out lateral

Fig. 73

Fig. 70. Red Fescue. Fig. 71. Fig. 72. Meadow Fescue.

shoots. Found in dry pastures near the sea-shore, in sandy soils. It is a grass of better quality than some of the other species, but is never cultivated in this country as an agricultural product. The color of its leaves is somewhat more grayish than the preceding, and often tinged with red. It is shown in Fig. 70, while its spikelet is seen magnified in Fig. 71.

Meadow Fescue (*Festuca pratensis*) is one of the most common of the fescue grasses. Shown in Fig. 72. It is said to be the Randall grass of Virginia. Its panicle is nearly erect, branched, close, somewhat inclined to one side; spikelets linear, with from five to ten cylindrical flowers,—a spikelet is shown magnified in Fig. 73;—leaves linear, of a glossy green, pointed, striated, rough on the edges; stems round, smooth, from two to three feet high; roots creeping; perennial. Its radical or root leaves are broader than those of the stem, while in most other species of fescue the radical leaf is generally narrower than those of the stem. Flowers in June and July, in moist pastures and near farm-houses.

This is an excellent pasture grass, forming a very considerable portion of the turf of old pastures and fields, and is more extensively propagated and diffused by the fact that it ripens its seed before most other grasses are cut, and sheds them to spring up and cover the ground. Its long and tender leaves are much relished by cattle. It is never or rarely sown in this country, notwithstanding its great and acknowledged value as a pasture grass. If sown at all, it should be in mixture with other grasses, as orchard grass, rye grass, or common spear grass. According to Sinclair, it is of greater value at the time of flowering than when the seed is ripe. It is said to lose a little over fifty per cent. of its weight in drying for hay.

In addition to its qualities as a pasture grass, it is said to make a very good quality of hay, much relished by cattle. The Randall grass is highly spoken of for fall and winter pastures in the climate of Virginia, and, as it often remains green under the snow through the winter, it is not unfrequently called "Evergreen grass."

Fig. 74. Tall Fescue Grass.

The TALL FESCUE GRASS (*Festuca elatior*) is also found pretty commonly in moist meadows and around farm-houses. Its panicle is contracted, erect, or somewhat drooping, with short branches, spreading in all directions; spikelets crowded, with five to ten flowers, rather remote, oblong, lanceolate; leaves flattish, linear, acute; stems two to four feet high; root perennial, fibrous, somewhat creeping, and forming large tufts. Fig. 74 shows this plant at the time of flowering, and Fig. 75 a magnified spikelet of the same. Flowers in June and July. Introduced from Europe.

Fig. 75.

It is a nutritive and productive grass,

growing naturally in shady woods, and moist, stiff soils. Cattle are very fond of it. Said by some to be identical with the meadow fescue.

The SLENDER SPIKED FESCUE (*Festuca loliacea*), Fig. 76, is a species nearly allied to the tall fescue, and possesses much the same qualities. It grows naturally in moist, rich meadows, forming a good, permanent pasture grass; but it is met with only very rarely among American grasses, and is of little value for cultivation. Fig. 77 shows a magnified flower of it.

The NODDING FESCUE (*Festuca nutans*) is also rarely met with in rocky woods. Panicle diffuse, composed of several long, slender branches, generally in pairs, nodding when ripe. Flowers close together; leaves dark green, often hairy; stem two to four feet high. From New England to Wisconsin and Minnesota, and thence northward and westward.

Fig. 76. Slender Spiked Fescue.

Fig. 77.

37. Bromus. *Brome Grasses.*

Spikelets from five to many flowered, panicled; glumes not quite equal, shorter than the flowers, mostly keeled, the lower one to five, the upper three to nine nerved; paleæ herbaceous, lower one convex on the back, or compressed, keeled, five to nine nerved; awned or bristle-pointed from below the tip; upper palea at length adhering to the groove of the oblong grain; fringed on the keel; stamens three; styles attached below the apex of the ovary. The grasses of this genus are coarse, with large spikelets, somewhat drooping generally when ripe.

Chess, Cheat, Willard's Bromus (*Bromus secalinus*), has a spreading panicle, slightly drooping; spikelets ovate, smooth, of a yellowish-green tinge, showing the rachis when in seed, and holding from six to ten rather distinct flowers. In the spikelet exhibited in Fig. 80 seven can be distinctly counted; the eighth or ninth, imperfectly developed, can often be found. Stems erect, smooth, round, from two to three feet high, bearing four or five leaves with striated sheaths; the upper sheath crowned with an obtuse, ragged ligule; the lower sheaths soft and hairy, the hairs pointing downwards; joints five, slightly hairy; leaves flat, soft, linear, more downy on the upper than on the under side; points and margin rough to the touch. *Summit of the large glume midway between its base and the summit of the second floret*, as seen in Fig. 80 (*b*), a constant mark of distinction from *Bromus racemosus* and *Bromus mollis*. Fig. 79 shows the form of this grass a few days before coming to maturity, and Fig. 81 a magnified spikelet, while Fig. 78 represents the same in a more advanced stage. Flowers in June and July. It has no relation to Italian rye grass, as has been claimed.

Distinguished from *Bromus arvensis* in the spikelets having fewer florets, and the outer palea being rounded

at the summit, and being broader compared with its length. In *Bromus arvensis* the outer pale is more conical.

Fig. 78.

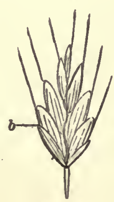

Fig. 80.

Fig. 81.

Fig. 79.

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Nothing more clearly illustrates the want of accurate knowledge of subjects intimately connected with agriculture, and immediately affecting the farmers' interests, than the more recent history of the propagation of this worthless pest to our grain-fields. It was, within the memory of many farmers who suffered from it, heralded in the papers, in connection with the names of distinguished friends of agriculture, with the earnest hope that it might receive extended trials. Monstrous prices were charged and paid by the farmer for its seed, in many cases four and five dollars a bushel, a pledge being exacted that it should not be allowed to go to seed. Committees of agricultural societies were invited to examine and report upon it; and in a letter now lying before me, the disinterested propagator very kindly offers to put up ten barrels of bromus-seed for one hundred dollars, saying that "of course the earliest applicants will be sure of obtaining till all is gone, which would scarcely give a barrel to a state. * * Years must elapse before the country can be supplied as it now is with Herd's grass and clover seed. My offer invites coöperation and participation in the profits and pleasures now available" — for taking advantage of the honest credulity of the public?

A quantity of bromus-seed was sent to the State Farm of Massachusetts, for the purpose of experiment, with a letter with directions to sow with clover, in the spring of 1855. The crop was cut while yet green, and before the grass had developed sufficiently to distinguish it with certainty. The following year directions were given to let it stand later in the season. While engaged in the collection and study of specimens, in the course of the summer of 1856, I gathered samples of the grass when it was still immature, the spikelets having precisely the form indicated in Fig. 79. Without giving it

a very close examination at the time, I pronounced it the *Bromus arvensis*, which, at that stage of its growth, it very much resembles. A few days after, I was astonished to see it develop into Chess (*Bromus secalinus*). This was the first ripe specimen of Willard's bromus I had seen. I examined it with care, and, to avoid the possibility of a mistake, I submitted specimens of it to Professor Gray, of Cambridge, and to Professor Dewey, of Rochester, New York, both of whom, after examination, pronounced it genuine chess.

But Mr. Willard having quoted from the report of a committee of an agricultural society, in which it was said that if a "jury of cows should confirm the opinion of Mr. Willard as to the superiority of the grass, then will the agricultural community owe him a debt of gratitude for having introduced to notice here a species of grass which is highly beneficial on light, sandy soils, much superior to any other species, and producing most abundantly on land of better quality," I directed it to be submitted to such a jury, which unhesitatingly pronounced a verdict in accordance with the facts, which were as follows:

The grass which was first submitted for comparison with the bromus was the reed canary grass (*Phalaris arundinacea*), a grass of very slight nutritive and palatable qualities. The upland or English hay used was such as commonly goes by that name among farmers, made up of Timothy and redtop mainly, of fair quality. The meadow or swale hay was taken from a wet meadow, and composed of coarse, swale grasses or sedges, such as are common in New England, and pass under the term of "meadow hay." The bromus was carefully picked out from all other grasses. The two kinds given in each trial were put into the same crib, but separated by a partition.

In the first trial, with bromus and reed canary grass, there was no choice. Both were eaten alike.

In the second, with bromus and English hay, the English hay was preferred.

In the third, with bromus and swale hay, the swale hay was eaten first.

In the fourth, with bromus and oat straw, the bromus was eaten first.

In the fifth, with reed canary grass and English hay, the English hay was preferred.

In the sixth, with reed canary grass and swale, the swale was chosen at once.

In the seventh, with reed canary grass and oat straw, the oat straw was chosen first.

In the eighth, with reed canary grass and corn-stalks, the corn-stalks were eaten first.

In the ninth, with bromus and corn-stalks, both were eaten nearly alike till they were gone.

In the tenth, with bromus and millet, the cattle chose the millet, and did not touch the bromus.

It is unnecessary to say that "Cheat" is a troublesome weed to the farmer, especially when it appears in his grain-fields. It is an early grass, but the quantity of herbage, and especially its quality, make it unfit for cultivation. Indeed, the only species of any value, or at all fit for cultivation, belonging to this large genus of grasses, is the *Bromus arvensis*, and even that has been discarded from modern agriculture. It may be valuable to sow with spring grain to turn in green.

SMOOTH BROME GRASS, or UPRIGHT CHESS (*Bromus racemosus*), has a panicle erect, simple, rather narrow, contracted when in fruit; flowers closer than in the preceding, lower palea exceeding the upper, bearing an awn of its own length; stem erect, round, more slender than in chess; sheaths slightly hairy. In other respects

it is very much like chess, but may always be distinguished from it, as well as from *Bromus arvensis*, in the summit of the large glume being half way between its base and the summit of the *third* floret, on the same side; whereas, in chess the summit of the large glume is half way between its base and the summit of the *second* floret. This character is constant, and offers the surest mark of distinction. It is common in grain-fields. It is worthless for cultivation except for green manuring.

Soft Chess, or Soft Brome Grass (*Bromus mollis*), is sometimes found. I procured beautiful specimens of it at Nantucket, where it was growing in the turf with other grasses, on a sandy soil near the shore. Its panicle is erect, closely contracted in fruit; spikelets conical, ovate; stems erect, more or less hairy, with the hairs pointing downwards, from twelve to eighteen inches high; joints four or five, slightly hairy; leaves flat, striated, hairy on both sides, rough at the edges and points; summit of the large glume midway between its base and the apex of the third floret, by which it is always distinguished from Willard's bromus. Flowers in June. Birds are fond of the seeds, which are large, and ripen early. Of no value for cultivation.

The Wild Chess (*Bromus kalmii*) is another species, found often in dry, open woodlands. It has a small, simple panicle, with the spikelets drooping on hairy peduncles, seven to twelve flowered, and silky; awn only one-third the length of the lance-shaped flower; stem slender, eighteen inches to three feet high; leaves and sheaths hairy. Flowers in June and July. Of no value for cultivation.

Fringed Brome Grass (*Bromus ciliatus*) is often found in woods and on rocky hills and river banks. It has a compound panicle, very loose, nodding; spikelets

seven to twelve flowered; flowers tipped with an awn half to three-fourths their length; stem three to four feet high, with large leaves. Flowers in July and August. Of no value for cultivation.

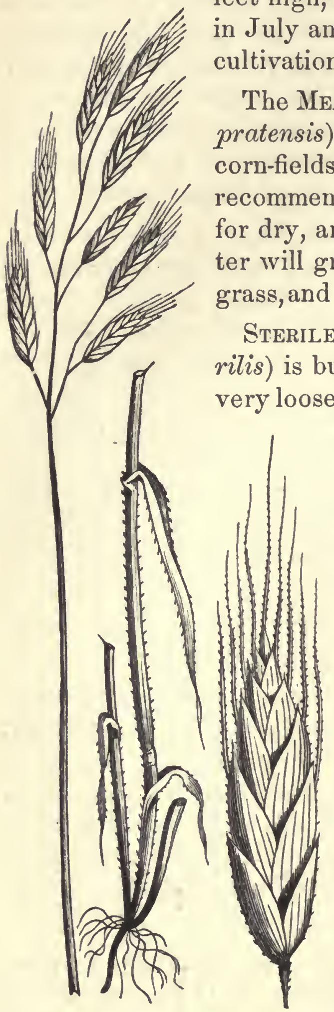

Fig. 82. Meadow Brome Grass. Fig. 83.

The MEADOW BROME GRASS (*Bromus pratensis*) is a perennial weed in the corn-fields of England, and is only recommended in any part of Europe for dry, arid soils, where nothing better will grow. Fig. 82 represents this grass, and Fig. 83 a magnified spikelet.

STERILE BROME GRASS (*Bromus sterilis*) is but rarely met with. Panicle very loose, the slender branches drooping; leaves hairy. Flowers in July.

Not one of the brome grasses is worthy of a moment's attention as a cultivated agricultural grass, and the cleaner the farmer keeps his fields of them the better.

38. UNIOLA. *Spike Grass.*

Spikelets flat, two-edged, many flowered; glumes compressed, keeled; paleæ of fertile flowers, two; the lower boat-shaped, the upper doubly keeled. Grain free, smooth, enclosed in the pales.

SPIKE GRASS (*Uniola paniculata*) is a grass found

on sand-hills along the coast from Virginia southward. Leaves narrow when dry; spikelets egg-shaped; stems from four to eight feet high. Of no value for cultivation.

BROAD-LEAVED SPIKE GRASS (*Uniola latifolia*), another species found on rich, shady hill-sides, from Pennsylvania to Illinois and southward, is known by its loose panicle; stem two to four feet high; leaves broad and flat; spikelets hanging on long pedicels. Flowers in August.

SLENDER SPIKE GRASS (*Uniola gracilis*) is still another species found on sandy soils on the coast from Long Island to Virginia, and further south. Stem rises three feet high, and slender.

39. PHRAGMITES. *Reed Grass.*

Glumes shorter than the flowers, keeled, sharp-pointed, and very unequal; rachis silky-bearded; paleæ slender, the lower thrice the length of the upper; styles long, grain free.

The COMMON REED GRASS (*Phragmites communis*) is a very tall, broad-leaved grass, with the flower in a large terminal panicle. It looks at a little distance very much like broom-corn; stem five to twelve feet high.

It grows on the borders of ponds and swamps, and is one of the largest grasses in the United States. It occurs in many localities in Massachusetts, and thence west to Illinois, Wisconsin, and Minnesota. Flowers in September.

40. ARUNDINARIA. *Cane.*

Glumes concave, awnless, small, lower smaller than the upper; scales three, longer than the ovary; stamens three, stems woody.

CANE (*Arundinaria macrosperma*) is a perennial grass, with a stem often from thirty to forty feet in height, and flowering in March and April. Leaves linear, green on both sides, smooth; spikelets seven to ten flowered, purple, smooth. In rich soils in southern Illinois, Indiana, Kentucky, Virginia, and southward. The stems are extensively used for fishing-rods.

41. LEPTURUS.

Flowers in spikes; rachis jointed; joints with one spikelet; glumes one or two, growing to the rachis, simple or two-parted.

SLENDER-TAIL GRASS (*Lepturus paniculatus*) is found in Illinois; an annual, flowering in June. Stem one foot high, compressed; leaves short, rigid; glumes fixed, rigid, unequal, parallel. Rare.

42. LOLIUM. *Darnel.*

Spikelets many-flowered, solitary on each joint of the continuous rachis, edgewise; glume only one, and external.

PERENNIAL RYE GRASS (*Lolium perenne*).—Stem erect, smooth, fifteen inches to two feet high; root perennial, fibrous; joints four or five, smooth, often purplish; leaves dark green, lanceolate, acute, flat, smooth on the outer surface, and roughish on the inner; glume much shorter than the spikelet; flowers six to nine, awnless. Flowers in June. Shown in Fig. 84. Fig. 85 represents a magnified spikelet of this grass.

It has had the reputation in Great Britain, for many years, of being one of the most important and valuable of the cultivated grasses. It is probably much better adapted to a wet and uncertain climate than to one subject almost annually to droughts, which often con-

tinue many weeks, parching up every green thing. There is, perhaps, no grass, the characteristics of which vary so much, from the influences of soil, climate, and culture, as perennial rye grass. Certain it is that this grass has been cultivated in England since 1677, and in the south of France from time immemorial. It is admitted to be inferior in nutritive value to orchard grass (*Dactylis glomerata*), when green.

Fig. 84. Perennial Rye Grass.

Whenever it is cut for hay, it is necessary to take it in the blossom, or very soon after, since otherwise it becomes hard and wiry, and is not relished by stock of any kind; and it changes very rapidly after blossoming, from a state in which it contains the greatest amount of water, sugar, &c., and the least amount of woody fibre, into the state in which it possesses the least amount of water, sugar, &c., and the greatest amount of woody fibre, and other insoluble solid matter. A specimen, analyzed about the 20th of June, and found to contain 81¼ per cent. of water, and 18¾ per cent. of solid matter, was found, only three weeks later, to contain only 69 per cent. water, and 31 of solid matter.

Fig. 85.

It is, undoubtedly, a valuable grass, and worthy of attention; but it is not to be compared, for the purposes of New England agriculture, to Timothy, or to orchard grass. It produces abundance of seed, soon arrives at maturity, is relished by stock, likes a variety of soils, all of which it exhausts; lasts six or seven years, and then dies out.

Fig. 86. Italian Rye Grass.

Fig. 87.

Italian Rye Grass (*Lolium Italicum*) has been recently introduced into this country, and is now undergoing experiment which will assist in determining its value for us. It differs from perennial rye grass in the florets having long, slender awns, and from bearded darnel (*Lolium temulentum*) in the glumes being shorter than the spikelets. This difference will be manifest on reference to Fig. 86, and Fig. 87, which represents a magnified spikelet. It turfs less than the perennial rye grass, its stems are higher, its leaves are larger and of a lighter green; it gives an early, quick, and successive growth, till late in the fall.

To say that it is, or would be, the best grass in our climate and on our soils, would be altogether premature; but it has the credit abroad of being equally suited to all the climates of Europe, giving more abundant crops, of a better quality, and better relished by animals, than the perennial rye grass. It is one of the greatest gluttons of all the grasses, either cultivated or wild, and will endure any amount of forcing by irrigation or otherwise, while it is said to stand a drought remarkably well.

The soils best adapted to Italian rye grass seem to be moist, fertile, and tenacious, or of a medium consistency; and on such soils it is said to be one of the best grasses known to cut green for soiling, affording repeated luxuriant and nutritive crops. I have not seen enough of it to speak from personal observation or experience of the comparative profit of this grass and Timothy for cultivation here; but its comparative nutritive value is well known from the thorough and reliable analyses of Professor Way. By these it appears that 100 parts of Timothy grass, as taken from the field, contain 57.21 per cent. of water, 4.86 per cent. of albuminous or flesh-forming principles, 1.50 per cent. of fatty matters, 22.85 per cent. of heat-producing principles, such as starch, gum, sugar, &c., 11.32 per cent. of woody fibre, and 2.26 of mineral matter or ash; while 100 parts of Italian rye grass, taken from the same kind of soil and in the same condition, green, contained 75.61 per cent. of water, 2.45 of albuminous or flesh-forming principles, .80 of fatty matters, 14.11 of heat-producing principles, starch, gum, and sugar, 4.82 of woody fibre, and 2.21 of mineral matter or ash. Of these, the flesh-forming principles, fatty matters, and heat-producing principles, are, of course, by far the most important; and in all these our favorite Timothy very far excels

the Italian rye grass, showing a nutritive value nearly double.

Nor has the Italian rye grass any advantage over Timothy in the dried state, though the difference is by

Fig. 88. Bearded Darnel.

Fig. 90.

Fig. 89. Many-flowered Darnel.

no means so marked; the former dried at 212° Fahrenheit containing 10.10 per cent. of flesh-forming principles, the latter 11.36; the former containing 3.27 per cent. of fatty matter, the latter 3.55; the former containing 57.82 per cent. of heat-forming principles, the latter 53.35.

There are 432,000 seeds in a pound of Italian rye grass, and from thirteen to eighteen pounds in a bushel.

The BEARDED DARNEL (*Lolium temulentum*), Fig. 88, is sometimes found in our grain-fields, with its glume equalling the five to seven flowered spikelets, and awn longer than the flower. Its grain is poisonous—almost the only instance known among the grasses.

The MANY-FLOWERED DARNEL (*Lolium multiflorum*) is, perhaps, the most showy species of rye grass cultivated. It is but very rarely, if ever, met with here, though it was introduced from France to England about thirty years ago, and is there cultivated to some extent. Fig. 89 shows the appearance of this grass, and Fig. 90 a magnified spikelet. It is very nearly allied to, if not identical with, Italian rye grass.

43. TRITICUM. *Wheat.*

Spikelets three to several flowered, compressed, with the flat side toward the rachis; glumes nearly equal and opposite, nerved; lower palea like the glumes, convex on the back, awned from the tip, upper flattened; stamens three; mostly annuals, but others are perennials, to which the couch grass belongs.

COUCH GRASS, QUITCH GRASS, TWITCH GRASS, DOG GRASS, CHANDLER GRASS, &c. (*Triticum repens*), seen in Fig 91, with its roots creeping extensively; stem erect, round, smooth, from one to two or two and a half feet high, striated, having five or six flat leaves, with smooth,

striated sheaths; the joints are smooth, the two uppermost very remote; leaves dark green, acute, upper one broader than the lower ones, roughish, sometimes hairy on the inner surface, smooth on the lower half. Inflorescence in spikes. A spikelet is seen magnified in Fig. 92. Flowers in June and July. Introduced from Europe.

Fig. 91. Couch Grass.

This plant is generally regarded by farmers as a troublesome weed, and efforts are made to get rid of it. Its long, creeping roots, branching in every direction, take complete possession of the soil, and impoverish it. When green, however, it is very much relished by cattle, and, if cut in the blossom, it makes a nutritious hay. Dogs eat the leaves of this grass, and those of one other species, for their medicinal qualities in exciting vomiting. I have seen acres of it on the Connecticut River meadows, where it

Fig. 92.

had taken possession and grew luxuriantly, and was called wheat grass, from its resemblance to wheat. It goes in different parts of the country by a great variety of names, as quake grass, quack grass, squitch grass. It is important to destroy it, if possible.

Bearded Wheat Grass (*Triticum caninum*) is found in woods and on the banks of streams, from New York to Wisconsin and northward. It has no creeping root-stalks, like couch grass. Spikelets four or five flowered; glumes three-nerved, rachis rough and bristly on the edges; awn longer than the smooth flower; leaves flat and roughish. It is perennial, and flowers in August; grows from one to three feet high. It is sometimes found in fields.

A variety of couch grass, the *Triticum dasystachyum*, is also found in Michigan and Wisconsin.

Wheat (*Triticum vulgare*). — See next chapter.

Egyptian Wheat (*Triticum compositum*) is cultivated in gardens as a curiosity.

44. Hordeum. *Barley Grasses.*

Spikelets one-flowered, with an awl-shaped rudiment on the inner side, three at each joint of the rachis, the lateral ones usually abortive or imperfect, short-stalked: glumes side by side in front of the spikelets, slender and bristle-form; lower pale convex, long-awned; stamens three; grain long, adhering to the pales.

Squirrel-tail Grass (*Hordeum jubatum*) is widely diffused over our salt marshes, and the shores of the northern lakes, in Wisconsin, Iowa, and Minnesota, and becomes a prairie grass in moist, level places. Stem slender, smooth, from one to two feet high, with rather short leaves, and low, lateral, abortive, neutral flowers, on a short pedicel, short-awned, the perfect flower

bearing an extremely long awn, about the length of the similar hairy glumes, all spreading. It is common on moist sands and marshes on the sea-shore, flowering in June.

BARLEY GRASS (*Hordeum pusillum*) grows from five to ten inches high, in saltish soils of Ohio, Illinois, and westward. Lateral flowers imperfect, awnless, pointed, the perfect flower awned; glumes rigid, short-awned. Annual. Much relished by cattle.

TWO-ROWED BARLEY (*Hordeum distichum*), as well as FOUR AND SIX ROWED BARLEY (*Hordeum vulgare*), belong to this genus. — See next chapter.

45. SECALE. *Rye.*

Spikelets two-flowered, flowers perfect, with the rudiment of a third terminal flower; glumes nearly equal, nearly opposite, keeled, awnless or awned; pales herbaceous, lower one awned, keeled, with sides unequal; upper shorter, two-keeled; scales two, entire; stamens three, ovary hairy; fruit free, hairy at the summit; spikes simple.

RYE (*Secale cereale*), a common cultivated plant, familiar to every farmer. — See next chapter.

46. ELYMUS. *Lyme Grasses.*

Spikelets two to four at each joint of the rachis, all fertile, each one to seven flowered; glumes both on one side of the spikelet; paleæ two, lower one usually awned, mostly perennial, some species annual.

LYME GRASS, WILD RYE (*Elymus Virginicus*), is frequent along the banks of rivers. It is known by its upright spike, dense and thick on a short peduncle, usually included in the sheath; two or three spikelets together, two or three flowered, smooth, shortly awned;

stamens three; stems stout, from two to three feet high; leaves broad and rough. Grows from two to three feet high, and flowers in July and August. Of no special value as an agricultural grass. Found from New England to Illinois and Wisconsin.

Canadian Lyme Grass (*Elymus Canadensis*).— Spike rather loose, and curving at the extremity; spikelets mostly in pairs of three to five, long-awned, rough, hairy flowers; the lance-awl-shaped glumes, tipped with shorter awns; stem three to four feet high, root creeping; leaves broad, flat, linear; sheaths smooth, and ligule short. Flowers in August. It is common on the banks of rivers.

Slender Hairy Lyme Grass (*Elymus striatus*) is sometimes found in rocky woods and on the banks of streams, as the most slender and smallest-flowered species of this genus. It flowers in July. Rare, and of little value for agricultural purposes.

Soft Lyme Grass (*Elymus mollis*) rises three feet high, on the shores of the northern lakes, Superior, Huron, and in higher latitudes. It has a thick, erect spike, with two or three spikelets at each joint, from five to eight flowered.

Upright Sea Lyme Grass (*Elymus arenarius*). — This grass, which much resembles beach grass, grows from two to five feet high, with a perennial, long, creeping root; stem erect, round, smooth; leaves long, narrow, hard, grayish, pointed, grooved, rolled in, smooth behind and rough on the inner surface. It flowers in July. Differs from the common beach grass in having a short, obtuse ligule, and spikelets without footstalks, of three or four florets, while beach grass has a long and pointed ligule, and spikelets with footstalks, and of only one floret.

Sinclair calls this grass the sugar-cane of Great Britain. It contains a large quantity of saccharine matter, and it is probable that mixed with beach grass, as it is in Holland, it would be valuable to cut up and mix with common hay for winter feed. It is used precisely as beach grass is here, to prevent the encroachments of the sea, and to arrest the drifting sand. It was introduced by the Patent Office, and cultivated in various parts of the country.

Bottle-brush Grass (*Elymus Hystrix*) is found rather commonly in moist, rocky woodlands, and along shaded banks of streams, and may be known by its loose, upright spike and spreading spikelets, smooth sheaths and leaves, smoothish flowers tipped with an awn three times their length. Flowers in July. It is referred by Gray to the genus *Gymnostichum*, as it differs from other species of *Elymus*, in having no glumes. The difference is slight, as the glumes are often more or less developed. The spike has the appearance of a bottle-brush, when ripe.

47. Aira. *Hair Grasses.*

Two-flowered spikelets, in an open, diffuse panicle; flowers both perfect, shorter than the glumes, hairy at the base; lower palea three to five nerved, awned on the back; grain oblong, smooth.

Wood Hair Grass, or Common Hair Grass (*Aira flexuosa*), is a common grass on our dry and rocky hills and roadsides. Stems slender, one to two feet high, nearly naked; leaves dark green, often curved, bristle-formed; branches of the panicle hairy, spreading, mostly in pairs; lower palea slightly toothed; awn starting near the base, bent in the middle, longer than the glumes, which are purplish. Perennial. Flowers in June. This plant is sometimes found thirty-five hundred feet above

the level of the sea. Sheep eat it readily. Of little value for cultivation. Fig. 93 represents it in blossom, and Fig. 94 a magnified flower.

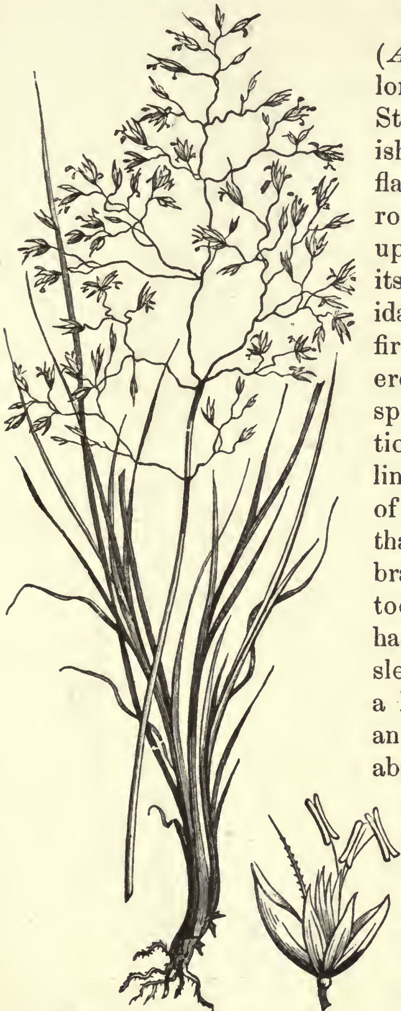

Fig. 93. Wood Hair Grass. Fig. 94.

Tufted Hair Grass (*Aira cœspitosa*) also belongs to this genus. Stems erect, round, roughish, in close tufts; leaves flat, linear, acute, with roughish striated sheaths, upper sheath longer than its leaf; panicle pyramidal or oblong, large, at first drooping, afterwards erect, with its branches spreading in every direction; awn barely equalling the palea; outer palea of lower floret shorter than the glumes; membranous, jagged, or four-toothed, on the summit, hairy at the base, with slender awn rising from a little above the base, and extending scarcely above the palea. Distinguished from wood hair grass in the awn of the lower floret not protruding beyond the glumes of the calyx. In wood hair grass the awn of the lower

floret protrudes more than one-third its length beyond the glumes.

It has an unsightly look in fields and pastures, on

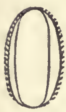

Fig. 99.

Fig. 100.

Fig. 98.

Fig. 96. Wild Oat Grass.

Fig. 97.

Fig. 95. Water Hair Grass.

account of its growing in tufts, clusters, or hassocks. Cattle seldom touch it. Natural to stiff or marshy bottoms, where the water stands. Flowers in June.

Purple Alpine Hair Grass (*Aira atropurpurea*) is another species found on the top of the White Mountains, in New Hampshire, growing from eight to fifteen inches high, with flat and rather wide leaves.

Water Hair Grass (*Aira aquatica*), Fig. 95. — This grass Mr. Curtis calls the sweetest of the British grasses, and equal to any foreign one. Its stems and leaves, when green, have a sweet and agreeable taste, like that of liquorice. Water fowls are said to be very fond of the seeds and the fresh green shoots, and cattle eat it very readily. It is strictly an aquatic, but can be cultivated on imperfectly drained bogs.

48. Danthonia.

Lower pale seven to nine nerved, with a flat and spirally twisting awn made of the three middle nerves. In other respects nearly like Avena.

Wild Oat Grass, White Top, Old Fog (*Danthonia spicata*), Fig. 96, is common in dry, sunny pastures, with a stem one foot high, slender, with short leaves, narrow sheaths, bearded; panicle simple; spikelets seven-flowered; lower palea broadly ovate, loosely hairy on the back, longer than its awl-shaped teeth — perennial. Flowers in June. It is called white top in some localities, but is not the grass most commonly known by that name. Its spikelet appears magnified in Fig. 97; its lower pale, in Fig. 98; its upper pale, in Fig. 99; its seed, in Fig. 100.

49. Trisetum.

Spikelets two to seven flowered, often in a contracted panicle; lower pale compressed, keeled, with a bent awn on the back.

Downy Persoon (*Trisetum molle*) is a grass with dense panicles, much contracted, oblong or linear, awn bent or diverging; lower palea compressed, keeled;

Fig. 101. Downy Oat Grass.

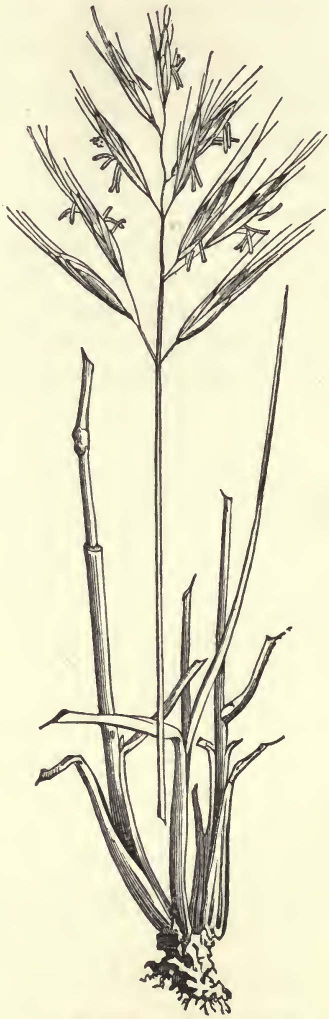

Fig. 102. Meadow Oat Grass.

leaves flat and short; found on rocky river-banks and mountains, about one foot high. It flowers in July. Of no agricultural value.

Marsh Oat Grass (*Trisetum palustre*) is a species found in low grounds, from New York to Illinois, and southward, from two to three feet high, leaves flat and short, spikelets yellowish-white, tinged green; panicle long, narrow, loose, hairy; spikelets flat.

The Downy Oat Grass (*Trisetum pubescens*) is a very hardy perennial grass, naturalized on chalky soils, and on such soils its leaves are covered with a coating of downy hairs, which it loses when cultivated on better lands. It is regarded as a good permanent pasture grass, on account of its hardiness and its being but a slight impoverisher of the soil, and yielding a larger per cent. of bitter extractive than other grasses grown on poor, light soils. It is, therefore, recommended abroad as a prominent ingredient of mixtures for pastures. It flowers early in July. Fig. 101 represents this plant as it appears in blossom.

50. Avena. *Oat.*

Spikelets three to many flowered, with an open, large, diffuse panicle; lower pale seven to eleven nerved, with a long, usually twisted awn on the back; stamens three; grain oblong, grooved on the side, usually hairy and free.

Meadow Oat Grass (*Avena pratensis*), Fig. 102, is a perennial grass, native of the pastures of Great Britain, growing to the height of about eighteen inches. It furnishes a hay of medium quality. Flourishes best on dry soils. Flowers in July. Figs. 103 and 104 represent the flowers of this grass magnified.

Fig. 103.

Fig 104.

The YELLOW OAT GRASS (*Avena flavescens*), Fig. 105, can scarcely, perhaps, be regarded as naturalized here. It is a perennial plant of slow growth and medium quality, cultivated to some extent in France, and suitable for dry meadows and pastures. It is sometimes regarded as a weed. It fails, if cultivated alone, but succeeds with other grasses, and is said to be the most useful for fodder of any of the oat grasses. It seems to grow best with the crested dog's tail and sweet-scented vernal. It contains a larger proportion of bitter extractive than most other grasses, and for that reason is recommended by some English writers as a valuable pasture grass. It flowers in July. Fig. 106 represents the flower of this grass magnified.

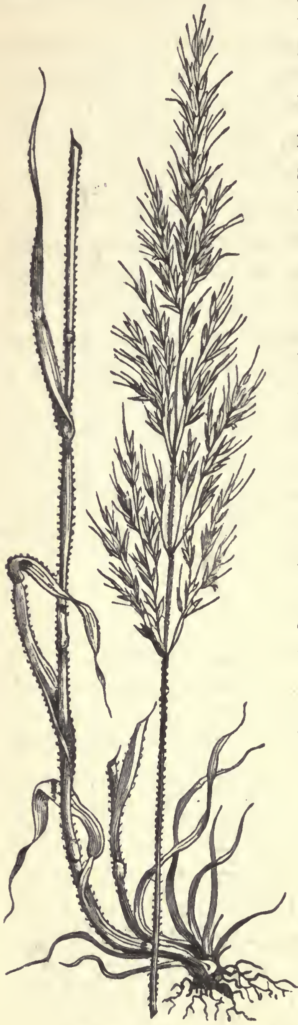

Fig. 105. Yellow Oat Grass.

PURPLE WILD OAT (*Avena striata*) is found on rocky, shaded hillsides, from New England and New York, northward. Stems tufted, from one to two feet high, and slender; leaves narrow; panicle loose and

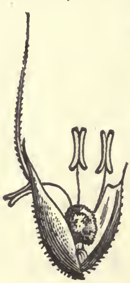

Fig. 106.

drooping, when ripe; lower pale with a short, bearded tuft at the base. It blossoms in June.

EARLY WILD OAT (*Avena præcox*) is a dwarf species, found in sandy fields from New Jersey to Virginia, growing only from three to four inches high; leaves short and bristle-shaped.

The COMMON OAT (*Avena sativa*) is well known to every farmer. — See next chapter.

51. ARRHENATHERUM. *Oat Grass.*

Spikelets two-flowered and a rudiment of a third, open; lowest flower staminate or sterile, with a long bent awn below the middle of the back.

TALL MEADOW OAT GRASS, OR TALL OAT GRASS (*Arrhenatherum avenaceum*), is the *avena elatior* of Linnæus. Spikelets open panicled, two-flowered, lower flower staminate, bearing a long bent awn below the middle of the back; leaves flat, acute, roughish on both sides, most on the inner; panicle leaning slightly on one side; glumes very unequal; stems from two to three feet high; root perennial, fibrous, sometimes bulbous. It is readily distinguished from other grasses by its having two florets, the lower one having a long awn rising from a little above the base of the outer palea. Introduced. Flowers from May to July. Shown in Fig. 107. A magnified spikelet is seen in Fig. 108.

This is the Ray grass of France. It produces an abundant supply of foliage, and is valuable for pasture on account of its early and luxuriant growth. It is often found on the borders of fields and hedges, woods and pastures, and is sometimes very plenty in mowing lands. After being mown it shoots up a very thick aftermath, and, on this account, partly, is regarded as nearly equal for excellence to the common meadow fox-

tail. It has been highly recommended for soiling, as furnishing an early supply of fodder.

Fig. 107. Tall Meadow Oat Grass.

Fig. 108.

It grows spontaneously on deep, sandy soils, when once naturalized. It has been cultivated to some extent in New England, and was at one time highly esteemed, mainly for its early, rapid, and late growth, making it very well calculated as a permanent pasture grass. It will succeed on tenacious clover soils.

52. Holcus. *Meadow Soft Grass.*

Spikelets two-flowered, jointed with the pedicels; glumes boat-shaped, membranaceous, enclosing and exceeding the flowers; lower flower perfect, its lower palea awnless and pointless; upper flower staminate only, bearing a stout bent awn below the apex. Stamens three; grain free, slightly grooved.

Meadow Soft Grass, Velvet Grass (*Holcus lanatus*), has its spikelets crowded in a somewhat open panicle, and an awn with the lower part perfectly smooth.

It grows from one to two feet high; stem erect, round; root perennial, fibrous; leaves four or five, with soft, downy sheaths; upper sheath much longer than its leaf, inflated, ligule obtuse; joints usually four, generally covered with soft, downy hairs, the points of which are turned downwards; leaves pale-green, flat, broad, acute, soft on both sides, covered with delicate slender hairs. Inflorescence compound panicled, of a greenish, reddish, or pinkish tinge; hairy glumes, oblong, tipped with a minute bristle. Florets of two paleæ. Flowers in June. Introduced. It is seen in Fig. 109, and its flowers magnified in Figs. 111 and 112.

This beautiful grass grows in moist fields and peaty soils, but I have found it on dry, sandy soils, and on upland fields, where it was cultivated with other grasses. It is productive and easy of cultivation, but of very little value either for pasture or hay, cattle not being fond of it. When once introduced it will readily spread

from its light seeds, which are easily dispersed by the

Fig. 109. Meadow Soft Grass.

Fig. 110. Creeping Soft Grass.

wind. It does not merit cultivation except on poor, peaty lands, where better grasses will not succeed.

Fig. 111.

Fig. 112.

Fig. 113.

Fig. 114.

The Creeping Soft Grass (*Holcus mollis*), Fig. 110, is of no value, and is regarded as a troublesome weed. Distinguished from the preceding by its awned floret and its creeping root. The flowers of this grass are seen magnified in Figs. 113 and 114.

53. Hierochloa. *Holy Grass.*

Panicle open, spikelets three-flowered; the two lower flowers staminate; glumes equalling the spikelet; leaves linear, flat.

Seneca Grass, or Vanilla Grass (*Hierochloa borealis*), has spikelets three-flowered; flowers all with two paleæ; branches of the panicle smooth; grows from twelve to eighteen inches high. Stems erect, round, smooth; panicle somewhat spreading, rather one-sided; leaves short, broad, lanceolate, rough on the inner side, smooth behind; spikelets rather large. Grows in wet meadows. Flowers in May. Common and generally diffused, but of no value for cultivation, on account of its powerful creeping roots, and very slight spring foliage.

This grass derived its generic name, *Hierochloa*, holy grass, from two Greek words, signifying sacred grass, from the fact that it was customary to strew it before the doors of the churches on festival and saint's days, in the north of Europe. In Sweden it is sold to be

hung up over beds, where it is supposed to induce sleep.

Alpine Holy Grass (*Hierochloa Alpina*) is found on mountain-tops in New England and New York, and northward. Panicle contracted, from one to two inches long. Lower leaves narrow. Flowers in July. Of no value for cultivation.

54. Anthoxanthum.

Spikelets three-flowered in spiked panicles; the lateral flowers neutral, consisting only of one pale, hairy on the outside, and awned on the back. Glumes very thin, acute, keeled, the upper twice the length of the lower, and as long as the flowers.

Sweet-scented Vernal Grass (*Anthoxanthum odoratum*). — Spikelets spreading, three-flowered; lateral flowers neutral, with one palea, hairy on the outside, and awned on the back; glumes thin, acute, keeled, the upper twice as long as the lower; seed ovate, adhering to the palea which encloses it; root perennial. Flowers in May and June. Stems from one and a half to two feet high. Introduced from Europe. It is seen in Fig. 115.

This is one of the earliest spring grasses, as well as one of the latest in the autumn, and is almost the only grass that is fragrant. It possesses a property said to be peculiar to this species, or possessed by only a few others, known as benzoic acid; and it is said to be this which not only gives it its own aromatic odor, but imparts it to other grasses with which it is cured. The green leaves when bruised give out this perfume to the fingers, and the plant may thus be known. It possesses but little value of itself, its nutritive properties being slight; nor is it much relished by stock of any kind; but as a pasture grass, with a large mixture of other species, it is valuable for its early growth.

It is not uncommon in our pastures and roadsides, growing as if it were indigenous.

Fig. 116.

Fig. 117.

Fig. 115. Sweet-scented Vernal.

Fig 119.

Fig. 118. Reed Canary Grass.

The aftermath or fall growth of this beautiful grass is said to be richer in nutritive qualities than the growth of the spring. Though it is pretty generally diffused over the country, it is only on certain soils that it takes complete possession of the surface, and forms the predominant grass in a permanent turf.

A curious and beautiful peculiarity is exhibited in the seeds of this grass, by which they are prevented from germinating in wet weather, after approaching maturity, and thus becoming abortive. The husks of the blossom adhering to the seed when ripe, and the jointed awn by its spiral contortions, when affected by the alternate moisture and dryness of the atmosphere, act like levers to separate and lift it out from the calyx, even before the grass is bent or lodged, and while the spike is still erect. If the hand is moistened, and the seeds placed in it, they will appear to move like insects, from the uncoiling of the spiral twist of the awns attached to them.

The flowers of the sweet-scented vernal grass are seen in Figs. 116 and 117. There are nine hundred and twenty-three thousand two hundred seeds in a pound, and eight pounds in a bushel. It cannot be said to belong to the grasses useful for general cultivation.

55. Phalaris. *Canary Grass.*

Spikelets crowded in a dense spiked panicle, with two neutral rudiments of a flower, one on each side, at the base of the flattish perfect one; awnless; two shining pales, shorter than the equal boat-shaped glumes, closely enclosing the smooth, flattened grain; stamens three.

Reed Canary Grass (*Phalaris arundinacea*) has a panicle very slightly branched, clustered, somewhat spreading when old, but not so much generally, as appears in Fig. 118; glumes wingless, rudimentary florets

hairy; stem round, smooth, erect, from two to seven feet high; leaves five or six in number, broad, lightish-green, acute, harsh, flat-ribbed, central rib the most prominent, roughish on both surfaces, edges minutely toothed; smooth, striated sheaths. Flowers in July. It grows on wet grounds by the sides of rivers and standing pools. There are about five hundred thousand grains or seeds of this grass to the pound. It may be gathered and sown with winter grain, to be ploughed in as a green manuring.

A beautiful variety of this species is the RIBBON or STRIPED GRASS of the gardens, familiar to every one. The reed canary grass will bear cutting two or three times in a season, but if not cut early, the foliage is coarse. Cattle are not very fond of it at any stage of its growth; but if cut early and well cured, they will eat it in the winter, if they can get nothing better. For some experiments with this hay in comparison with others, see page 106.

This grass is not unfrequently produced by transplanting the roots of the striped grass into suitable soils. In one instance, within my knowledge, it came in and produced an exceedingly heavy crop, simply from roots of ribbon grass, which had been dug up from a garden and thrown into the brook, to get them out of the way. Several other instances of a similar nature have also come to my notice. One farmer has propagated it extensively in his wet meadows by forcing the ripe seed-panicles into the mud with his feet. As the stripe of the ribbon grass is only accidental, dependent on location and soil, it constitutes only a variety of the reed canary grass, and loses the stripe when transferred to a wet and muddy soil.

The cut, Fig. 118, was made from a specimen too far advanced to show this grass as it ordinarily appears;

the panicle or head is too spreading, and not sufficiently long. I have fine specimens with panicles three times as long as appears in the drawing, and more in the shape of a spike of Timothy.

To ascertain the exact nutritive qualities of this grass when cured as hay, a careful analysis has been made, at my request, by Prof. E. N. Horsford, of Cambridge, with the following result: Of water, the specimen contained 10.42 per cent.; ash, 5.31 per cent.; nitrogen, .55 per cent.; nitrogenous ingredients, flesh-forming principles, 3.53 per cent.; woody fibre, starch, gum, sugar, &c., 80.73 per cent. It will be seen, by reference to a subsequent page, containing analyses, by Prof. Way, that this grass is very far inferior to many other grasses examined by him. The panicles of this grass, if allowed to stand after the time of flowering, become filled with ergot, or long, black spurs, issuing from between the glumes, and occupying the place of grain. This, if there were no other reason, would be sufficient to determine that it should be cut at or before the time of flowering. I have never seen rye worse affected than my specimens of this grass are. The effects of this mysterious disease are well known. The noxious power it exerts on the system of animals, which receive even a small portion of it, is oftentimes dreadful, producing "most horrible gangrenes, rotting of the extremities, internal tortures, and agonizing death. It has been known to slough and kill not a few human beings, who have accidentally or inadvertently eaten grain or flour infected with it."

The flower of the reed canary grass is shown in Fig. 119. The variety called striped grass (*Colorata*) is exceedingly hardy, and may be propagated to any extent by dividing and transplanting the roots. In moist soils it spreads rapidly, and forms a thick mass of

fodder, which might be repeatedly cut without injury, though it is of little value for feeding stock.

The COMMON CANARY GRASS (*Phalaris Canariensis*) is cultivated in gardens, and to some extent in fields and waste places, for the sake of the seed for the canary-bird. It has a spiked, oval panicle; glumes wing-keeled; rudimentary flowers smooth, and half the length of the perfect one. Flowers in July and August.

56. MILIUM. *Millet Grass.*

Spikelets diffusely panicled, not jointed with their pedicels; stamens three; stigmas branched; grain not grooved, enclosed in the pales, all falling together.

MILLET GRASS (*Milium effusum*) is found growing commonly in moist, shady woods, mountain meadows, and on the borders of streams. Panicle widely diffuse, compound; glumes ovate, very obtuse; leaves broad and flat, thin; root perennial; flower oblong. Flowers in June. Introduced. Of no value for cultivation, except as a green manuring plant, the foliage possessing but slight nutritive qualities. The seeds are millet-like, one hundred and fifty thousand to the pound, and are sought by birds. It will thrive transplanted to open places.

DOUBLE-BEARING MILLET GRASS (*Milium purshii*) is found on the moist, sandy pine barrens of New Jersey. Referred by Gray to Amphicarpum.

57. CYNOSURUS.

Spikelets three to five flowered, with a comb-like involucre at the base of each; inflorescence racemed; florets tipped with a rough awn.

CRESTED DOG'S-TAIL (*Cynosurus cristatus*).—Fig. 120. This grass is rarely found here, but has been

introduced and cultivated to some extent by way of experiment. Its spikes are simple, linear; spikelets awnless; stems one foot high, stiff, smooth; root perennial, fibrous, and tufted. Flowers in July. It is said to be a valuable permanent pasture grass; but cattle seldom eat it after it is ripe, on account of its wiry stems. On dry, hard soils and hills, pastured with sheep, it would doubtless be of value for its hardiness. At the time of flowering it is tender and nutritious. A magnified spikelet is shown in Fig. 121.

Fig. 120. Crested Dog's-tail.

The stems of this grass are used for the manufacture of plat for Leghorn hats and bonnets, and have the reputation of being equal or superior to Italian straw. They are gathered green when in blossom, immersed in boiling water for ten minutes, and then spread out to bleach for eight days. Another mode of treatment is to keep them in boiling water for an hour, and then spread them out, and keep them moistened

Fig. 121.

regularly till they become dried, or for two days, when they are placed in a tight vessel and subjected to the fumes of burning sulphur for two hours.

58. Paspalum.

Spikelets spiked, or somewhat racemed, in two or four rows on one side of a flattened rachis, jointed, with thin, short pedicels, awnless, apparently but one-flowered, and differing from *Panicum* in wanting the lower glume. Stamens three.

Floating Paspalum (*Paspalum fluitans*) is a grass found in low swamps from Virginia to Illinois, and southward. Stems smooth, and rooting in the mud or floating. Of no value for cultivation.

Hairy Slender Paspalum (*Paspalum setaceum*) has an erect or decumbent, slender culm, from one to two feet high, leaves and sheaths hairy; spikes slender, smooth, mostly solitary, on a long peduncle, spikelets narrowly two-rowed. Flowers in August. It is found on sandy fields and plains near the coast, and is rather common from Massachusetts to Illinois, and southward.

Smooth Erect Paspalum (*Paspalum lœve*) is also found on moist soils, from New England to Kentucky, and southward. It has an erect, stout stem, from one to three feet high; leaves long and large, with smooth or slightly hairy flattened sheaths; spikelets broadly two-rowed. Flowers in August.

Joint Grass (*Paspalum distichum*) is common on wet fields in Virginia and southward, flowering in July and August. It grows about a foot high, from a long, creeping base. Spikes short and closely flowered; rachis flat on the back; spikelets egg-shaped and slightly pointed.

Finger-shaped Paspalum (*Paspalum digitaria*) is also found in Virginia, and further south, growing from one to two feet high; spikes slender and sparsely-flowered.

59. Panicum. *Panic Grasses.*

Spikelets panicled or racemed, sometimes spiked; glumes two, the lower one short, minute, or wanting; lower flower neutral, rarely awned, upper perfect; stamens three; stigmas usually purple.

Slender Crab Grass (*Panicum filiforme*) is an annual finger grass, somewhat resembling the Finger-shaped Paspalum, but the *upper glume equals the flower*, while the lower is nearly wanting, and the spikes are more erect. It flourishes on sandy, dry soils, especially near the coast. Flowers in August.

Smooth Crab Grass (*Panicum glabrum*) resembles the last, with the spikes digitate, three to four, spreading; rachis flat and thin, spikelets ovoid. It is common in cultivated grounds, waste places, and on sandy fields. Flowers in August and September. A troublesome weed.

Finger Grass, Common Crab Grass (*Panicum sanguinale*). — The panic grasses are widely spread and common all over the country.

The stems of the Finger Grass are from one to two feet high, erect, spreading; leaves and sheaths hairy; spikes four to fifteen; digitate; upper glume half the length of the flower; lower one small. It grows on waste or neglected cultivated grounds and gardens, and yards, and is generally regarded as a troublesome weed. Introduced. Flowers from August to October.

Double-headed Panic (*Panicum anceps*) is found on the wet pine barrens of New Jersey to Virginia, and

south. Stems flat, two to four feet high. Flowers in August.

Agrostis-like Panic Grass (*Panicum agrostoides*) has flattened, upright stems, two feet high; leaves long, sheaths smooth; spikelets on the spreading branches, crowded, and one-sided, *ovate, oblong, acute*, purplish. It is common on wet meadows and borders of rivers, from Massachusetts to Virginia, Illinois, and southward. Flowers in July and August.

Prolific Panic Grass (*Panicum proliferum*) grows on brackish marshes and meadows, and is common along the coast from Massachusetts southward, and along the Ohio and Mississippi Rivers. It sometimes appears on dry places. Cattle are fond of it. It differs from the preceding in having culms thickened, succulent, branched, and bent, ascending from a procumbent base, and spikelets appressed, lance-oval, of a pale-green color.

Hair-stalked Panic Grass (*Panicum capillare*) grows in sandy soils and cultivated fields everywhere. Its culm is upright, often branched at the base, and forming a tuft; sheaths flattened, very hairy; panicle pyramidal, hairy, compound, and very loose; spikelets scattered, on long pedicels, oblong, pointed. Flowers in August and September.

Autumn Panic (*Panicum autumnale*) grows about a foot high, with very slender stems, branching below. Found from Illinois southward.

Tall Smooth Panic Grass (*Panicum virgatum*).— Stems upright, three to five feet high; leaves very long, flat; panicle large, loose, and compound; branches spreading when grown, and drooping; spikelets scattered, oval, pointed; glumes usually purplish. Grows

pretty commonly in moist, sandy soils, especially at the South; flowers in August.

Bitter Panic (*Panicum amarum*) is found on sandy shores, from Connecticut to Virginia, and further south. Flowers in August and September.

Broad-leaved Panic Grass (*Panicum latifolium*).—This is a grass with a perennial, fibrous root, and stem from one to two feet high; with leaves broad, long, taper-pointed, smooth or slightly downy; branches of panicle spreading; spikelets long, obovate, downy. Flowers in June and July. It is common in moist thickets and woods. Of no value for cultivation.

The Hidden-flowered Panic Grass (*Panicum clandestinum*) is found in low thickets, and on the banks of streams, from one to three feet high, very leafy to the top, the joints naked; sheaths rough, and bearing very stiff and spreading bristly hairs. Flowers from July to September.

Yellow Panic Grass (*Panicum xanthophysum*) grows on dry, sandy soils, from Maine to Wisconsin, and northward. It is of a yellowish-green color, the spikelets downy; sheaths hairy; leaves lanceolate, acute, smooth, except on the margins.

Sticky Panic Grass (*Panicum viscidum*) grows with an upright stem, leafy to the top, densely velvety, downy all over, including the sheaths, with reflexed, soft, often clammy hairs, except a ring below the joint; panicles spreading; spikelets long and downy. Moist soils, from New Jersey to Virginia, and southward.

Common Millet (*Panicum miliaceum*).—Flowers in large, open, nodding panicles; leaves lance-shaped, broad; stem one to two feet high; native of Turkey. It is shown in Fig. 122.

Many varieties of millet have at times been culti-

vated in this country, and its culture is gaining favor every year. Millet is one of the best crops we have for cutting and feeding green for soiling purposes, since its yield is large, its luxuriant leaves juicy and tender, and much relished by milch cows and other stock.

The seed is rich in nutritive qualities, but it is very seldom ground or used for flour, though it is said to exceed all other kinds of meal or flour in nutritive elements. An acre, well cultivated, will yield from sixty to seventy bushels of seed. Cut in the blossom, as it should be, for feeding to cattle, the seed is comparatively valueless. If allowed to ripen its seed, the stalk is no more nutritious, probably, than oat straw.

Millet requires good soil, and is rather an exhausting crop, but yields a produce valuable in proportion to the richness of the soil, and care and expense of cultivation.

Few-flowered Panic (*Panicum pauciflorum*) is found in wet meadows, from New York to Wisconsin, and southward. Stems upright, from one to two

Fig. 122. Common Millet.

feet long, roughish; panicle open. Flowers in June and July.

POLYMORPHUS PANIC (*Panicum dichotomum*) is common in all parts of the country, on dry and low grounds. Lower glume roundish, one-third or a quarter the length of the five to seven nerved upper one.

WORTHLESS PANIC (*Panicum depauperatum*) is also common northward, in dry woods and hills. Stems simple, forming close tufts, terminated by a simple and few-flowered contracted panicle, often overtopped by the upper leaves.

WARTY PANIC (*Panicum verrucosum*) is found in sandy swamps, near the coast, from New England to Virginia, and southward. Stems branching and slender, smooth, one to two feet high; leaves shining; branches of the diffuse panicle slender, few-flowered; spikelets oval, roughish with warts, dark-green. Flowers in August.

BARN GRASS, or BARN-YARD GRASS (*Panicum crus-galli*), is very common. Its spikes are alternate and in pairs, sheaths smooth, rachis bristly; stem from two to four feet high, stout, erect, or somewhat procumbent; leaves half an inch broad; panicle dense, pyramidal; glumes acute; awn variable in length, and sometimes wanting; outer palea of the neutral flower usually awned. One or two varieties have rough or bristly sheaths. It grows on moist, rich, or manured soils, and along the coast in ditches. Flowers in August, September, and October.

Some experiments have been made to cultivate this common species in the place of millet, to cut for green fodder. It is relished by stock, and is very succulent and nutritive, while its yield is large.

HUNGARIAN GRASS, HUNGARIAN MILLET (*Panicum Germanicum*), has been cultivated to considerable extent in this country, from seed received from France thro' the U.S. Patent Office.

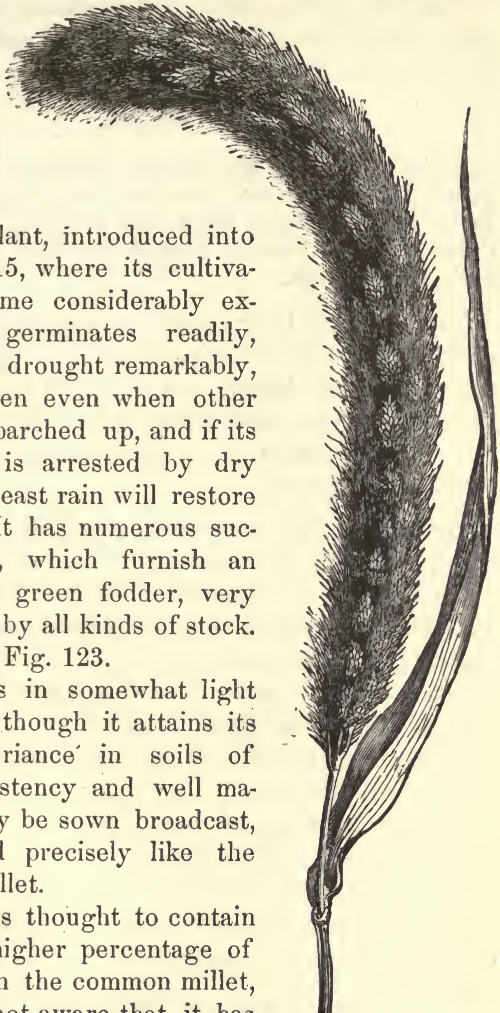

Fig. 123. Hungarian Grass.

It is an annual forage plant, introduced into France in 1815, where its cultivation has become considerably extended. It germinates readily, withstands the drought remarkably, remaining green even when other vegetation is parched up, and if its development is arrested by dry weather, the least rain will restore it to vigor. It has numerous succulent leaves, which furnish an abundance of green fodder, very much relished by all kinds of stock. It is shown in Fig. 123.

It flourishes in somewhat light and dry soils, though it attains its greatest luxuriance in soils of medium consistency and well manured. It may be sown broadcast, and cultivated precisely like the varieties of millet.

This grass is thought to contain a somewhat higher percentage of nutriment than the common millet, though I am not aware that it has been analyzed. It is a leafy plant,

and remains green until its seeds mature, and is no doubt valuable for fodder, both green and dry, growing and maturing in about the same time as common millet. From twenty-five to thirty bushels of seed to the acre have been obtained.

60. Setaria.

Spikelets as in the genus Panicum, awnless, with short peduncles or flower-stalks produced beyond them into solitary or clustered bristles, like awns. Inflorescence in dense, spiked panicles, or cylindrical spikes. Annuals.

The Bristly Foxtail (*Setaria verticillata*) is a grass sometimes, though rarely, found about farm-houses. It has cylindrical spikes two or three inches long, pale-green, somewhat interrupted with whorled, short clusters, bristles single or in pairs, roughened or barbed downwards, short.

Bottle Grass, sometimes called Foxtail (*Setaria glauca*). — This is an annual, with a stem from one to three feet high; leaves broad, hairy at the base; sheaths smooth; ligule bearded; spike two to three inches long, dense, cylindrical; bristles six to eleven in a cluster, rough upwards; perfect flower wrinkled. The spike is of a tawny or dull orange-yellow, when old. Flowers in July. It is common in cultivated grounds and barn-yards. Introduced.

The Green Foxtail, sometimes also called Bottle Grass (*Setaria viridis*), has a cylindrical spike, more or less compound, green; bristles few in a cluster, longer than the spikelets; flower perfect, striate lengthwise and dotted. It is common in cultivated grounds.

The Bengal Grass, sometimes called Millet (*Setaria italica*), also belongs to this genus. It has a compound

spike, thick, nodding, six to nine inches long, yellowish or purplish; bristles two or three in a cluster. Introduced from Europe.

61. CENCHRUS. *Bur Grasses.*

Spikelets enclosed, one to five together, in a roundish and bristly covering, which becomes a hard bur.

BUR GRASS, or HEDGEHOG GRASS (*Cenchrus tribuloides*), is somewhat common on sandy soils on the coast, or near the salt water, where the spikes are whitish, and around the great northern lakes. It is regarded as a troublesome weed, on account of its prickly burs. Stems branched at the base, from one to two feet high; leaves flat; spike oblong.

62. TRIPSACUM. *Gama Grass.*

Spikelets in jointed spikes, staminate above, and fertile below; staminate spikelets two, both alike; two-flowered; lower glume nerved; upper boat-shaped; pales thin, awnless; anthers opening by two pores at the apex; stems tall and large, solid, from thick, creeping roots; leaves broad and flat.

GAMA GRASS, or SESAME GRASS (*Tripsacum dactyloides*), is one of the largest and most beautiful grasses, though not one that would be considered of much value where better could be grown. Its stalk is from four to seven feet high, and the leaves look not very unlike those of Indian corn. Grows on moist soils, near the coast, from New England to Pennsylvania, west to Illinois, and more common at the South, in Louisiana, and adjoining states, where it is indigenous. It is a stout, coarse, and hardy grass.

63. ERIANTHUS. *Woolly Beard.*

Spikelets in pairs on each joint of the slender rachis, one on a pedicel, the other connected at its base, crowded

in a panicle, and clothed with long, silky hairs. Stamens one to three. Grain free.

Woolly Beard Grass (*Erianthus alopecuroides*) is found on the wet pine barrens of New Jersey, in Illinois, and at the South. It grows from four to six feet high; woolly-bearded at the joints; panicle contracted; silky hairs longer than the spikelets.

Short-awned Woolly Beard (*Erianthus brevibarbis*) is also found on low grounds, in Virginia and southward, growing from two to five feet high, and somewhat bearded at the upper joints. Panicle rather open.

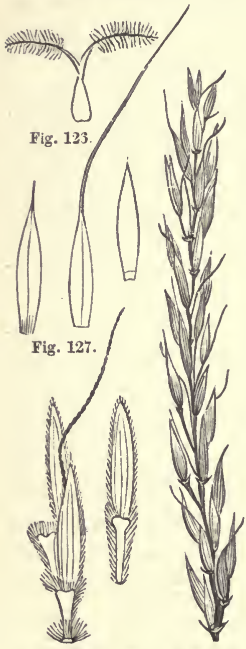

Fig. 123. Fig. 127. Fig. 125. Fig. 124.

64. Andropogon.

Spikelets much the same as in the preceding genus, bearing a neuter or staminate lower flower; glumes and paleæ often wanting; upper flower perfect; glumes awnless; lower palea awned. Flowers in panicles and spikes. Most of these grasses are coarse and hard perennials, having lateral or terminal spikes, commonly clustered or digitate, with the rachis hairy or feathery-bearded.

Finger-spiked Wood Grass (*Andropogon furcatus*) grows about four feet high; leaves nearly smooth; spikes digitate, or generally by threes and fours; lower flower awnless; the spikelets roughish, downy; the awn bent. Flowers in September. A spike of this grass is shown in Fig. 124, a part of it enlarged in Fig. 125, its pistil in Fig. 126, its glumes in Fig. 127. It is common on sterile soils, rocky banks, and hill-sides.

Purple Wood Grass, Broom Grass (*Andropogon scoparius*), is found on sterile, sandy soils, flowering from July to September. It grows from two to four feet high, with many-branched panicles; lower sheaths and narrow leaves hairy; spikes mostly single, very loose, slender, slightly silky, with dull, white hairs; rachis zigzag, hairy along the edges.

Silver Beard Grass (*Andropogon argenteus*) grows about three feet high, with spikes in pairs, on peduncles exceeding the sheaths, dense, and very silky. Common on sterile, sandy soils, in Virginia and southward, flowering in September and October.

Virginian Beard Grass (*Andropogon Virginicus*) grows on similar soils to the last, from New York to Illinois, and southward. Stem flattish below; slender, short-branched above; sheaths smooth; spikes soft, two or three in distant clusters.

Cluster-flowered Beard Grass (*Andropogon macrourus*) is found from New York to Virginia, southward on the coast. Stems from two to three feet high, bushy, branched at the summit, with many spikes, forming thick, leafy clusters; sheaths rough, the upper hairy.

65. Sorghum.

Spikelets two or three together, in an open panicle, the lateral ones sterile, middle fertile; stamens three.

Indian Grass, Wood Grass (*Sorghum nutans*), is a grass sometimes found on our dry, sterile soils, with a panicle oblong, somewhat compressed, from six to ten inches long; stem from three to five feet high; leaves linear, grayish; sheaths smooth; spikelets light brown and glossy, drooping when mature; hairy at the base; awn twisted. It flowers in August.

INDIAN MILLET (*Sorghum vulgare*) is a cultivated species, and has several well-marked varieties. It is called Guinea corn in the West Indies, Dhourra in Arabia, Jovaree in India, and Nagara in the north of China. It is sometimes used as a forage plant.

The tall cereal, which has long been cultivated in the south of Europe and in Barbary, under the general name of sorghum, resembles Indian corn in quality, and is often called *small maize.* Its stems contain a pretty large per cent. of saccharine matter, and it is useful to cut green as a forage plant.

Indian millet, when raised on good soil and under favorable circumstances, is said to yield a larger quantity of seed to the acre than any other cereal grass known, not excepting even Indian corn. Its nutritive quality is nearly equal to that of wheat. The common millet is the *panicum miliaceum.*

BROOM CORN (*Sorghum saccharatum*) is considered by some botanists as a variety of *Sorghum vulgare;* by others, as a distinct species. Its leaves are linear; ligules short and hairy; panicle with long, loose, expanding branches. It is an annual, and flowers in August, growing from six to nine feet high. Native of India.

The panicles are used for brooms, and the seeds for poultry, swine, &c. It is extensively cultivated in many parts of the country along the Connecticut River, in Massachusetts, the Mohawk, in New York, and at the West. It is said to have been first cultivated in this country by Dr. Franklin, who found a seed on a stalk in the possession of a lady, and planted it.

CHINESE SUGAR-CANE, SORGHO, or SORGHO SUCRE (*Sorghum nigrum*), is a plant well known throughout the United States. It rises with a stem from six to fifteen feet high, according to the soil on which it grows, erect,

smooth; leaves linear, flexuous, gracefully curving

Fig. 128. Chinese Sugar Cane.

down at the ends, resembling Indian corn in its early growth, and broom corn, to which it is nearly allied, at maturity. Flowers in a panicle at the top, at first green, changing through the shades of violet to purple, when more advanced. It is seen in Fig. 126.

This plant has lately been introduced and used for forage, and experiments have been made with it for the manufacture of molasses or sirup and sugar.

It is rich in saccharine matter, and a large amount of nutritive fodder can be obtained from it.

It grows best on a dry soil, and under a hot sun, and is usually planted in the same manner as Indian corn, both as to preparation of ground and time of planting; generally in hills when it is intended to ripen its seed, and in drills when it is wanted to cut up green for soiling purposes, or to cure and feed out in winter as a forage crop.

Various opinions have been expressed, by practical farmers, as to the comparative value of this new addition to our cultivated plants, and these opinions have been influenced much by the locality in which it was grown.

Its culture, which was extensive in New England during the first year or two after its introduction, has been, to a great extent, abandoned there, while further experiments, in other sections of the country, have been attended with greater satisfaction.

It has usually received the specific name of *Sorghum saccharatum*, *Holcus saccharatus*, &c., names which had been previously applied to another plant. It seems proper to yield to the prior claim, and I prefer to specify it as the *Sorghum nigrum*.

The SUGAR-CANE (*Saccharum officinarum*) is a tropical grass closely allied to Erianthus. It has a simple, undivided, jointed, and smooth stem, often two inches in

diameter, and from ten to twenty feet high; leaves long and pointed; flowers small, on a terminal, loose panicle; glumes two, oblong, pointed, equal, concave, with the base surrounded with woolly hairs; a perennial, fibrous root.

The culture of several new varieties of sugar-cane is said to have been introduced into the Southern States, towards the close of the last century, from the islands of Bourbon, Java, and Otaheite.

The sugar-cane is propagated from cuttings. It was undoubtedly cultivated at a very early date in China and India, from whence it was introduced into Europe. The culture of cane and the making of sugar has become an exceedingly important business at the West India Islands, in Louisiana, and adjoining states.

The top joints of the stalks are selected for cuttings, they being least valuable, and less productive in saccharine matter than the lower parts. The plant tillers or sends up several shoots from the same root, like wheat.

The land, after being properly prepared, is marked out in rows, about four feet apart, and in these rows holes are dug, from six to ten inches deep, about two or three feet apart. The plants require frequent hoeing and cultivation, but not to be renewed from cuttings every year.

When the canes are ripe, they are cut up, cut into suitable lengths, and tied into bundles to be taken to the mill. Sugar-making requires experience and skill.

66. Zea. *Maize.*

Spikelets two-flowered; flowers monœcious, the staminate in terminal panicles; glumes two; pales awnless, obtuse; the pistillate or fertile spikelets two-flowered, with the lower one abortive; glumes two, obtuse; pales awnless; fruit compressed.

INDIAN CORN, MAIZE (*Zea mays*), is a true grass, familiar to everybody in this country, and by far the most important and extensively cultivated of any plant known to our agriculture.

The practice of sowing Indian corn in drills, for the purpose of cutting up green for fodder, was recommended some years ago by a progressive agriculturist, and, though at first ridiculed, it soon came to be planted in small patches of a few rods square, by practical farmers here and there, till now it is regarded as almost an indispensable crop, not only to carry a stock of cattle through a severe summer drought, when our pastures are short and dry, but to cut and cure in large quantities for winter use. The weight and value of an acre of corn fodder is very large.

A more extended notice of this plant will be given in the next chapter.

CHAPTER II.

THE CEREALIA; OR, THE GRASSES CULTIVATED FOR THEIR SEEDS.

We have dwelt thus far chiefly upon the grasses, both cultivated and wild, which are used to greater or less extent as food for stock, either in the green and succulent stage of their growth, or cured for winter forage. In this chapter I propose to speak briefly of the cereals, or the grasses which are cultivated mainly on account of the large size of their farinaceous or mealy seeds.

The *Cerealia* might properly be considered a genus of the great family of plants which forms the subject of this treatise, the *Gramineæ*, especially when taken from a practical point of view. The term itself was derived from Ceres, deified by the ancients as the beautiful goddess of corn, and it includes a class of plants by far the most important of any in the known world.

The cereals are all annuals, and they die down after having fulfilled their natural destiny — the production and ripening of their seeds. In structure they resemble the grasses of which we have already spoken; that is, they all have hollow stems, divided or closed at the joints, while from these joints start sheaths which rise, clasping the stems, but open or divided on one side. The ears or heads of the cereals consist of many flowers, arranged either in spikes, as in wheat, or panicles, as in oats, rice, and millet. They have three stamens.

This class of plants consists chiefly of rice, wheat,

barley, rye, oats, millet, and Indian corn, all true grasses, which in some respects resemble each other, and form a group by themselves.

Fig. 129.

Rice (*Oryza sativa*) is a long panicled grass, having, when ripe, some resemblance to oats, the seed growing in a separate pedicel starting from the main stalk. Each kernel terminates in an awn, and is enclosed in a rough husk, or scale, of a yellowish color. The stem or stalk of rice is similar to that of wheat, except that the joints are more numerous. It is annual, and rises to the height of from two to six feet, according to the variety, soil, and culture. A stalk of rice, with its spiked panicle, is shown in Fig. 129.

Rice-meal is composed, to a great extent, of starch, with but a comparatively small percentage of gluten, which forms a large proportion of good wheat-flour. The seed is surrounded with a husk, which is so closely attached to it as to be difficult of separation. It is cleaned by passing through mill-stones, set far enough apart to prevent crushing the grain, but sufficiently near to remove the husks or chaff by friction.

Rice, doubtless, originated in Asia, where it is known to have been extensively used for many ages, and where, from the earliest times of which we have any record, it has formed the chief and most important food of the inhabitants. It is also at the present time largely produced in Egypt, and forms an important article of commerce, and a productive source of wealth. The facilities for irrigation afforded by the River Nile make it

comparatively easy of cultivation. The grain is there separated from the husk by means of pestles and mortars.

The introduction of rice as a cultivated plant in the United States is of modern date. It was brought to South Carolina from the island of Madagascar towards the close of the seventeenth century, and, though for many years no means of cleaning it effectually were known, yet its cultivation extended, till finally the methods of cleaning were so far perfected as to justify the reputation which the growers acquired, of producing the best rice in the world.

The swamps and the climate of South Carolina are so admirably adapted to this plant that its culture is carried on at comparatively small expense of labor, while the grain itself arrives at great perfection, and is acknowledged to be of very fine quality, being generally larger than in the countries where it was originally grown. It has now become an exceedingly important article of export.

Rice requires a great supply of moisture; and, unless rains are frequent, or the means of irrigation are at hand, it will prove unproductive.

There are several varieties. They originated, probably, in differences of soil, climate, and culture.

The common rice requires for its successful cultivation a wet marsh, and on any other situation it fails to grow. It may be considered as almost an aquatic plant. Another variety, known as early rice, requires a similar soil, but is smaller, and comes to maturity earlier, and will generally ripen in about four months; while common rice requires six months.

Mountain rice will succeed with less moisture. I am not aware that this variety has been cultivated, to any extent, in this country.

Clammy rice will grow both on swamps and uplands.

Rice is generally sown in drills, into which it is dropped by hand; after which the water is let on for several days, to the depth of some inches, when it is removed till the rice has sprouted and grown to the height of from two to four inches. The water is then again let on, and suffered to remain for some days. This destroys the grass and weeds, if any. After this it is occasionally hoed and cultivated, to keep it free from weeds.

The harvest commences generally in August, and continues through September; and it is generally cut with sickles, and gathered up into bundles.

Rice is very extensively cultivated in China and in India, and along the River Po, in Lombardy. It is probably used as human food by a larger number than any other cereal grain.

Wheat.

Wheat (*Triticum vulgare*) is an annual herbaceous plant, of many varieties, all arising, probably, from the same parent, but modified by varieties of climate, soil, and culture.

Wheat possesses, of course, the same general characteristics as the rest of the gramineæ. The seed is oblong, or a compressed oval, surrounded by scales or chaff, which are easily removed. That side of the kernel or fruit which was next to the rachis in growing is marked by a deep groove separating the mealy parts in the middle. On the other side a small oval is seen. This is the seat of the embryo, or place where the germ of the new plant is to take its start. This is also the point of attachment of the pedicel on which the kernel grew, and through which it derived all its growth and nourishment. On arriving at maturity a detachment takes

place at this point, and it closes up so as to leave the seed free in its pales or husks, from which it is easily separated.

The stalk or stem and leaves of the wheat plant, as indeed of all the cerealia or grain plants, differ from the other grasses in containing a much greater amount of woody fibre, often amounting, when ripe, to three-fourths of the whole weight. It is largely composed of silex, a hard, flinty substance, which gives the stem its firmness and solidity, and especially its hard and glossy outside coating.

Were it not for this hard stem, it could not support its weight of ears or grain. It would lodge in every wind, and be comparatively worthless.

The cultivated plants belonging to the genus *Triticum* are annuals, the others are wild perennial grasses.

The root of wheat is peculiarly adapted to withstand the severity of the winter's cold. The main or seminal root is pushed out at the same time with the germ, and that nourishes the plant in its early growth. As many as seventy-two stalks have been known to rise from a single root.

The grain is composed to a great extent of starch, with a large percentage of gluten and other nitrogenous bodies.

Fig. 130.
Hungarian Wheat.

Fig. 131.

The two prominent and most striking varieties of

wheat are known as winter *Triticum hybernum*, and spring *Triticum œstivum.*

Winter wheat has generally a larger and plumper ear, smooth and awnless, and a stronger, harder, and more erect stem. It is sown in autumn, and soon germinates, remaining green through the winter, and starting up into a vigorous growth early the next spring, arriving at maturity in the following summer. Some of the varieties of winter wheat are shown in Figs. 130 and 131.

There are many sub-varieties of winter wheat, which originated, probably, from influences of locality, soil, and culture. The two prominent groups are best known as the red and white wheats. The red is usually the more hardy, and is covered with a thicker and rougher coating, which adapts it better to high northern latitudes, and severe winters.

The amount of glutinous and silicious substances (bran) is said to be greatest in the red. and least in the white, while it is medium in the amber.

Spring wheat is less hardy than winter; the stem is more slender and delicate, the ear smaller and thinner, and rather more drooping, and adorned with long awns or beards. It produces, ordinarily, less than the winter wheat, while the quality of its flour is less esteemed; but still it often becomes profitable for cultivation, and is a valuable variety.

Le Couteur makes the following classification of the endless varieties and sub-varieties into which both the summer and winter wheats have passed.

BEARDLESS OR WINTER WHEATS.

1 White Wheats, smooth chaffed.
2 " " velvet husked.
3 Red " smooth chaffed.

4 Red Wheats,	velvet husked.	
5 Yellow	"	smooth chaffed.
6 "	"	velvet husked.
7 Liver	"	smooth chaffed.
8 "	"	velvet husked.

BEARDED OR SPRING WHEATS.

1 White Spring Wheat.
2 Red Spring Wheat.
3 Yellow Spring Wheat.
4 Hoary Spring Wheat.

Among the varieties of winter wheat which have been cultivated to any extent in this country may be mentioned the common White Flint, improved White Flint, the White Provence Wheat, the Wheatland Red, the Tuscan Bald, the Skinner Wheat, the Golden Drop, the White Blue Straw, known in Ohio as the Blue Stem, the Aguira Wheat, the Verplanck, the Canada Flint, the Bearded Mediterranean, Old White Flint, the Club, the Genesee, the Egyptian, the Old Red Chaff, the Quaker Wheat, the Yellow Bearded, the Kentucky Red, the Bald Mediterranean, the Red Blue Stem, and innumerable others.

Among the spring varieties may be mentioned the Italian Spring Wheat, Tea Wheat, or Siberian Wheat, Black Sea Wheat, Black Bearded and Red Bearded Wheats, the Scotch Wheat, Talavera Wheat, the Black Tea Wheat, the Canada Club, the Fife, &c.

All varieties may be easily modified by cultivation. The bearded may become beardless, and vice versa; the red may pass into the white varieties, and the winter is easily modified so as finally to become a spring wheat.

A variety known as spelt, or spelt wheat (*Triticum spelta*), is shown in Fig. 132, while a summer variety is shown in Fig. 133, Egyptian wheat in Fig. 134, and one-seeded wheat (*Triticum monococcum*), or St. Peter's corn, in Fig. 135.

As already intimated, wheat is composed chiefly of starch, the percentage of which varies from fifty to seventy per cent.; of gluten, the percentage of which varies from ten to twenty; and of from three to five per cent. of fatty matters. The best flour contains, therefore, seventy pounds of starch, or upwards, in every hundred pounds, and the balance is made up of glu-

Fig. 132.

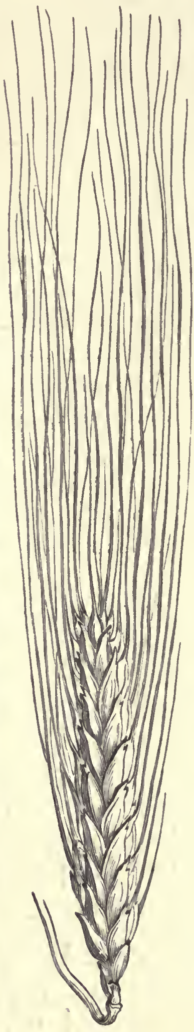

Fig 133.

Fig. 134.

Fig. 135.

ten, sugar, water, and oil. Starch is the most important ingredient for the nourishment of the young plant or the germ.

Wheat contains a greater amount of nourishment, also, for the human system, than the same quantity of almost any other vegetable product. A bushel of wheat, or sixty pounds, when ground into flour, will make about forty-seven pounds of what may be called bread-flour; about four and a quarter pounds of fine Pollard, or mixture of bran and meal; about four pounds of coarse Pollard, two and three-fourths pounds of bran, and there will be a loss, on an average, of about two pounds, making in all sixty pounds.

There are two methods of cultivation in general practice in this country, the old method of sowing broadcast, and the drill system, which is the more economical of the two, as it effects a saving of seed, and greater security against what is called heaving out by the frost, while the crop is usually greater, particularly if the plant is cultivated, during its growth, as it may be, between the drills. Very perfect drilling machines are now in use in wheat-growing sections of the country.

Barley.

Barley (*Hordeum vulgare*) has generally a more slender seed than that of wheat, and a firmer and rougher covering of husk or chaff. It has also a longer awn, or beard. Its amount of starch is about the same as that of wheat, some analyses showing it to be greater, and others less; but its amount of gluten is less. It contains, also, several per cent., ordinarily from six to eight, of uncombined saccharine matter.

The average length of a grain of barley, or the mean of many thousand measurements, is .345 of an inch, or not far from a third of an inch, from which was derived

the barleycorn of the old linear measure. The average weight per bushel is between fifty and fifty-one pounds.

The native country of barley is as unknown as that of wheat. There is a tradition among the Egyptians that barley was the first grain used by mankind, and they trace its introduction, as a cultivated plant, to the goddess Isis. It was cultivated in Syria more than three thousand years ago; for we read that Ruth gleaned in the field till evening, and beat out what she had, and it was about an ephah of barley, and she gleaned till the end of the barley harvest.

The grasses referred by botanists to the same genus as barley have a strong outward resemblance to it; but none of them, by any degree of culture, can be improved so as to be of service as food, so that they give no indication as to the origin of the grain in question; and as we know it to have been used in Syria from a very remote antiquity, it is natural to infer that it originated in that country. There are four distinct species of barley, and from these have arisen a great number of varieties.

The common barley, or the *Hordeum vulgare*, Fig. 136, is a spring species, and this is the kind most commonly cultivated. It is six-rowed, the rows being slightly irregular, the intermediate ones being a little the most prominent. This is extensively cultivated in Germany. It has passed into a six regular rowed variety, which is a winter grain of a somewhat shorter ear, and shells more easily when ripe, endures more severe colds, and may be cultivated as a winter variety. It is shown in Fig. 137.

Two-rowed Barley (*Hordeum distichum*), Fig. 138, is sometimes cultivated in this country. Its spike, or ear, is long and somewhat compressed, and the grain is of a very good quality. It is sown in spring.

There is also the true winter barley, the *Hordeum hexasticum*, or square barley, and the *Hordeum zeocriton*,

Fig. 136. Common Barley.

Fig. 137.

Fig. 138. Two-rowed Barley.

or sprat barley. A beardless variety, the *Hordeum trifurcatum*, is also known to some extent, but possesses no advantages for cultivation, that I am aware of, over the more common varieties.

Barley is probably cultivated over a wider range of climate and latitude than any other cereal. In warm climates it passes through its various phases of vegetation with astonishing rapidity, so as to escape the droughts of summer; and in cold climates its growth is even more rapid, coming to maturity before the frosts of autumn. Linnæus found it growing in Lulean Lapland, in latitude 67° 20′, where the harvest began on the 28th July, the seed having been sown only six weeks.

In the warmer climate of Spain, two crops may be taken from the same ground, by sowing in autumn and the following summer. In this respect, therefore, barley has the advantage of being more important to mankind than even wheat.

Barley succeeds best in soils of medium consistency, but accommodates itself to almost every variety of soil, except very moist ones. It endures a drought better than excessive moisture, but it requires as deep and good tillage as wheat, and may take the same place in the rotation as winter wheat or rye. It takes from the soil a larger percentage of mineral substances, as potash, lime, magnesia, phosphoric acid, &c., than wheat or rye, and these substances should, in some form, be restored to

the soil that is repeatedly cropped with barley. Liquid manures are extensively used for it in Flanders, and they promote its rapidity of vegetation; but too stimulating animal manures cause it to run too much to stalk.

> "When the oak puts on his gosling gray,
> 'T is time to sow barley night and day,"

is an old maxim, handed down to the Norfolk farmers, from which it appears that experience had shown the first budding of the oak, previous to the expansion of its leaves, as the best time to sow this grain. The most extensive use of barley at the present time is for brewing and distilling, a use of it which dates back to the remotest antiquity, and which is said to be due to the monks.

The best and heaviest grain is desirable. The composition of barley and the malt made from it are essentially different, and may be stated as follows:

	Barley.	Malt.
Gluten,	3	1
Sugar,	4	16
Gum,	5	14
Starch,	88	69
	100	100

The quantity of barley annually consumed for brewing in Great Britain exceeds thirty millions of bushels, and from this more than eight millions of barrels of beer are yearly brewed.

Barley is extensively used in eastern countries as food for horses, but has never gained so great favor in cooler latitudes. It is a less heating feed than the oat.

Barley ought to be reaped before it becomes dead ripe. In this state the husk is thick, making it more difficult grinding. The approaching period of ripeness is indicated by the yellowness of the straw and the drooping of the heads.

Barley contains, on an average, about sixty-five per cent. of nutritive matter, while wheat contains about seventy-eight per cent. According to the elaborate experiments of Thaer, the comparative value of wheat, barley, and oats, for feeding stock, may be represented by 47, 32, and 24, taking the same quantity of each. The soil on which these grains are cultivated has, no doubt, much to do with their composition.

Rye.

Rye (*Secale cereale*) is said to be a native of the island of Candia. It is a plant intermediate between wheat and barley.

The general characteristics have been stated in the preceding chapter. It is so nearly allied to the genus *Triticum*, that it is not always easily distinguished from it. There are four prominent species, known to botanists as *Secale villosum*, or tufted rye; *Secale orientale*, or dwarf oriental rye; *Secale creticum*, or Cretan rye, and *Secale cereale;* the last being the only one cultivated in this country for its seeds.

It is characterized by long-bearded spikes, or ears, and a tall and slender stem. The glumes of the calyx are toothed on the edges; the root is fibrous and annual; the stem jointed, somewhat branched at the bottom, and smooth. The spike is terminal, solitary, erect, and often three or four inches long; the awns straight, rough, erect, and four or five times the length of the glumes. The plant is shown in Fig. 139.

Of this there are two prominent varieties, known to farmers as winter and spring rye, and due to culture mainly.

The variety most commonly cultivated, and which is represented in the figure, is known as winter rye; and this is to be preferred, whether it is sown for the grain

or the straw. Its characters as a variety are so little fixed that it may be sown at almost any season of the year, with the hope of getting a crop, in the proper season for it, either of grain or green fodder. It is far less sensitive to the cold of winter than wheat, while its vegetation is more rapid, so that in high northern latitudes it is often a more important crop.


Fig. 139. Rye.

The cultivation of rye does not essentially differ from the other grains. It is usually sown broadcast on a well-cultivated soil, but will succeed on lighter soils than wheat, and does not require so much moisture as either wheat or barley. Wheat, in particular, must have a considerable mixture of clay, or what would be called a clay loam, or a clay subsoil, to arrive at its full perfection as a remunerative crop. It succeeds admirably on the calcareous soils of the western prairies. But rye requires less moisture than wheat, and will do very well on light, sandy loams, and in a comparatively dry season.

The grain or kernel of rye is smaller in size than that of wheat. It tillers much less in growing, and its straw, or stem, when ripe, is very rich in silica; more so than that of wheat, while it contains a larger percentage of potash and phosphoric acid than the latter. Manures containing a large amount of phosphates and silicates of potash would seem, therefore, to be highly important for rye, as, indeed, they are for all the cereals.

Rye straw, though of little value for fodder, is in great demand for litter, and for various mechanical purposes, and commands a high price, varying in the Boston market from ten to fifteen dollars a ton. But it is as a fodder-plant, and particularly for soiling in early spring, that it is now extensively used and highly prized. For this purpose it is sown in the autumn, the earlier the better, after other crops come from the ground, and in early spring it starts up luxuriantly, and is fit to be fed off by sheep and lambs, or to cut at the height of six inches. At this stage of its growth, and before it begins to spindle, it is succulent and nutritious; but, as soon as this period of its growth is reached, it loses its succulent qualities, and is no longer relished by stock.

Rye has sometimes been parched and ground as a substitute for coffee; but it wants the grateful aroma and the stimulating properties of the favorite Mocha bean, and it can hardly come into general use.

Rye sown with wheat produces a mixed crop known as *meslin*, which forms one of the healthiest kinds of bread that it is possible to make, and practical millers much prefer wheat and rye grown together to any mixture of the two that have been grown separately. The comparative value of wheat and rye is about as 71 to 64, according to the most accurate experiments and analyses.

But rye may be cultivated longer on the same soil than almost any other crop of the farm. This is a fact which has often been noticed by practical farmers.

Rye contains a large per cent. of gluten, larger than any of the cereals except wheat, while about five per cent. of it consists of ready-formed saccharine matter, which makes it easily converted into malt, and so into beer and other spirits, particularly that known as "Hollands," which is distilled from rye, flavored with juni-

per, the Dutch for which is *Genever*, from which comes *Geneva*, contracted in *Gin*.

Rye is subject to a fatal disease, known as ergot; and when attacked with it is often called spurred rye. It is most destructive in wet seasons, and is commonly ascribed to a fungous growth, the poisonous effects of which, when taken into the system of either men or animals, were observed as early as 1596. It is, fortunately, not very prevalent in this country, but sometimes develops itself in rye, as well as in some of the other grasses, as June grass and reed canary grass, and in some other species.

Oats.

The Oat (*Avena sativa*) derives its English name from a Saxon word signifying to eat; while its generic name, *avena*, comes from a Latin word, signifying to desire, from the fact that cattle are fond of it.

This plant differs considerably, in appearance, from either wheat, rye, or barley. It grows in panicles, the calyx being two-valved or two-seeded; the seeds smooth, and one-awned; the root annual; the stem growing from two to three feet high. The two glumes, or the chaff of the calyx, are nerved, pointed at the end, longer than the flower, and unequal. The two flowers and seeds in each calyx are alternate, conical in shape; the smaller awnless, the larger furnished with a strong, bent awn, of two colors. The branches of the panicle are erect when green, but droop as the seed ripens, from its weight.

The only species cultivated for its seeds, the *avena sativa*, has passed into many varieties, such as the Potato Oat, the Siberian, the Tartarian, the Poland, the White, the Black, the Horse-mane Oat, &c. The first is undoubtedly one of the very best of these varieties,

being the most productive, and making the best quality of meal, though it requires a somewhat richer soil than other varieties. It was found growing accidentally in a heap of manure with some potato-plants, and hence its odd name. Its grain is large and plump. The common oat is seen in Fig. 140.


Fig. 140. Oats.

For poor lands, the Tartarian or the Siberian is said to be preferable. The Poland has a thick husk and a coarse straw. The white varieties are known by many local names, though there are but slight differences between them. Oats require good loamy or stiff soil to produce the largest crops, and do best in a moist climate or wet season. They are generally sown broadcast, and harrowed or rolled in. Many farmers are accustomed to allow them to stand too long and get over-ripened. In this case they shell too easily, thus causing considerable loss, while the straw becomes comparatively worthless for feeding purposes. As soon as the stem turns yellow below the head or panicle, the crop should be cut, without delay.

It has been often remarked by farmers that other crops in the rotation follow oats better than any other grain.

The nutritive qualities of oats are less than those of any other grain, taking weight for weight, very rarely exceeding, even in the first quality, 75 per cent.; while those of wheat, for instance, often exceed 95 per cent. They are used mainly as food for horses in this country, the use for any other purpose being comparatively limited. In France and Germany the practice of baking oats and rye together in loaves as food for horses is said to be gaining ground.

The quantity of oats required to seed an acre properly is from three to four bushels. Many farmers overseed, and use from four to six bushels, but without reaping in proportion to what they had sown.

For the purpose of ascertaining, so far as one experiment could throw light upon it, the requisite quantity to seed an acre fully and economically, experiments were instituted at the State Farm, in Massachusetts, in the spring of 1858, and with the following results:

The oats were sown broadcast, on the 27th and 28th days of April, and harrowed in:

Lot No.	1,	at the	rate of	five	bushels	to the acre,	yield	42	bushels.
"	2,	"	"	four	"	"	"	35½	"
"	3,	"	"	three	"	"	"	40	"
"	4,	"	"	two	"	"	"	26½	"

The lots consisted of an acre and a half each, and were manured with one hundred pounds of plaster of Paris per acre, spread broadcast, and harrowed in, except a strip of one acre, running across all the lots, which received no plaster. The oats were harvested on the 28th of July, and thrashed on the 2d and 3d days of September.

The yield of lot number one was forty-two bushels; of number two, thirty-five bushels and a half; of number three, forty bushels; of number four, twenty-six and a half bushels.

The acre that received no plaster yielded twenty and a half bushels. The grain weighed twenty-eight pounds to the bushel, and was pretty uniform on all the lots, that on number one being the lightest, both in grain and straw.

The crop was small, the land being unfavorable for oats; but it will be perceived that the lot seeded with three bushels to the acre produced forty bushels, while that seeded with five bushels produced only forty-two bushels.

The experiment, though exceedingly unsatisfactory in other respects, seems to indicate that the use of five or six bushels is more than is needed, and that three or four are sufficient, especially on land that is well cultivated and prepared.

A good yield of oats is from sixty to seventy-five bushels per acre, and this is often obtained without any extraordinary culture.

Indian Corn.

Indian Corn (*Zea mays*) was found under cultivation by the Indians, on the discovery of the New World, and was, unquestionably, of American origin. Its generic name was derived from a Greek word, signifying *to live*, and was applied to this plant on account of the farinaceous or mealy nature of the seeds.

Indian corn, or maize, grows with a strong, jointed stalk, rising to the height of from five to fifteen feet, with large, alternate leaves starting from each joint, as shown in Fig. 141. The male or sterile flowers, Fig. 142, are arranged in a loose, spreading panicle at the apex, called the tassel, and the female or fertile flowers, Fig. 143, on the side.

Each plant bears from one to four or five ears, Fig. 144. As many as six or eight have sometimes been

found on some of the varieties. The ears are cylin-

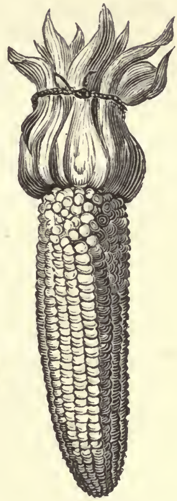

Fig. 144.

Fig. 145.

Fig. 142.

Fig. 143.

Fig. 141. Indian Corn.

drical, and enclosed in a covering of leaves, in the form of sheaths, called the husks. The ears consist of the fruit or grain, arranged in rows around a pithy cylinder, called the *cob*. The number of rows varies from eight to thirty-six, but does not usually exceed fourteen or sixteen, while the number of grains in a row is from thirty to forty. These seeds are rounded on the surface, and compressed on the sides, and from the germ or eye of each a silky or thread-like style or filament of a bright-green color extends along the inner side of the husks, and hangs down, forming together a thick cluster, called the *silks*. These receive the pollen or farina as it falls from the staminate flowers of the tassel. The seed could not attain perfection unless it received this pollen by means of its silk, a fact which can be easily proved by cutting off the tassels of all the stalks growing together, before their flowers develop. Indian corn is an annual, and, owing to the mealy quality of its seeds, is one of the most important of all the cultivated plants.

There is but one species referred by botanists to this genus, *zea*; but of this, there are innumerable varieties, due to climate, soil, and culture. These varieties are distinguished by the size and color of the grains, the number of rows on the ear, the length of time required to come to maturity, and other characteristics, which can hardly be said to be fixed and permanent, as they are easily modified by culture.

Indian corn is extensively used as human food, and for feeding and fattening domestic animals, and holds the highest rank among the cereals, whether its nutritive qualities, or the produce and return for the seed sown, or its range of climate, be regarded.

Cotton is sometimes said to be king; but if, in American agriculture, the genius of which is truly republican,

where all the great staples form so important a part in promoting the national prosperity, one can be said to hold preëminence over the rest, the palm must be yielded to the golden corn, rearing its imperial form and tasselled banner high over all its compeers, and founding its claim to royalty, as the prince of cereals, by the universality of its uses, and its intrinsic importance to mankind.

Its flexibility of organization is truly wonderful; for while it grows best on moist, rich soils, and with great heats, there are varieties of it which can be raised at the height of more than eight thousand feet above the level of the sea. The warmest regions of the torrid zone produce it in abundance, while the short summers of Canada have varieties adapted to them, and arrive at maturity with almost the same certainty as those under a hotter sun, and a longer season.

According to some analyses, Indian corn furnishes in its composition 88.43 per cent. of fat-forming principles, gum, &c.; 1.26 per cent. of flesh-forming principles, 9 per cent. of water, and 1.31 per cent. of salts. Its chemical composition shows it to be among the most fattening of the cereals, and this is also the result of experience. For our domestic animals, therefore, and as a means of raising and fattening them, Indian corn may justly be regarded as superior even to wheat.

No part of the plant is necessarily lost, or thrown aside as worthless. Even the cob is ground, and, for some purposes of feeding to stock, it is very valuable; while, if it were necessary, the plant would supply us with a large amount, and a very good quality, of sugar.

As already intimated, the varieties of Indian corn are innumerable. Among the favorites for high latitudes in this country, as in Maine, New Hampshire, &c., may be mentioned the Early Canada, the old Eight-rowed Yellow, and with some the King Philip, or Brown corn,

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though the latter has not met the expectations raised for it by the United States Patent Office. A variety known as the Smutty White is also largely cultivated in some sections of Massachusetts, and its yield is greater than most others adapted to northern latitudes. The Turkish White Flint, the Early Dutton, Peabody's Prolific, the Golden Sioux, the Kentucky Field, the Wyandotte, the White Gourd-seed, the Tuscarora, and many others, might be named.

In addition to these prominent varieties, which are, in some sections, cultivated as field crops, might be mentioned several well-marked varieties of Sweet corn, such as Stowell's Evergreen, the Asylum, the Old Colony sweet corn, and Darling's Early, to say nothing of several other favorite early varieties.

There is a variety known as the Rocky Mountain corn, the kernels of which are each covered with glumes or husks, which they lose, on cultivation, in the course of three or four years. In addition to these, many small-eared varieties used for parching, and known as Pop corn, are cultivated to a limited extent in all parts of the country, and among them Rice corn and Calico corn.

The culture of Indian corn is simple, and easily understood. It requires a deep, rich, and mellow soil, thoroughly tilled. After ploughing, the land is carefully marked off in rows from three to four feet apart each way, according as the variety is large or small, when four or five kernels are dropped in a hill, either by hand or machine, and covered to the depth of from one to two inches. After the corn is up, it is cultivated with the horse hoe or plough, to keep it free from weeds. It is sometimes hilled at the last hoeing; at others the ground is left level, which is thought to be the best.

When Indian corn is planted as a fodder crop, or to

be cut and fed out green, it is sown in drills instead of hills. For this use it is one of the most valuable and important plants we have.

Most of the operations in the culture and harvesting of Indian corn may be performed by machinery. Husking, one of the slowest and most irksome processes connected with it, may now be well and quickly done, at a great saving of time and labor over the old methods.

In selecting corn for seed, the tips of the ears are thought to be best, and that part near the butt end of the ear next in value. The common practice in New England, for many years, has been to use only the seeds which grow on the middle of the ear.

The experiment of planting seed taken from different parts of the ear has been repeatedly tried, and the result has almost uniformly been better from that taken near the tips, however contrary it may be to the theories hitherto received, in regard to the full and complete development and perfection of seed. One farmer, within my knowledge, followed up his experiment for

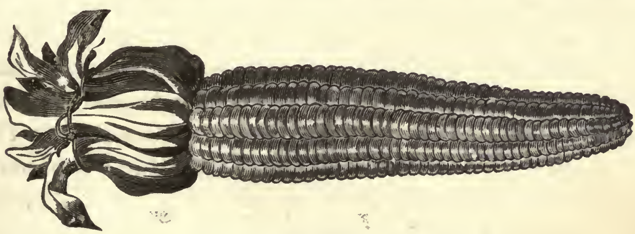

Fig. 146.

ten years, planting only the corn from the small end of the ears, choosing such as were well filled out, then selecting only that from the middle of the ears, and then only that from the large ends. After ten years, he found that in seven years of the ten the crop from the small ends was the largest and best.

A similar experiment was tried at the State Farm of Massachusetts, in the summer of 1858.

Two acres were planted, on a light soil, well adapted to Indian corn, manured with seven and a half cords of barn-yard manure to the acre, spread broadcast and cultivated in, and ten bushels of leached ashes and one hundred pounds of gypsum to the acre, put in the hill. The corn was planted on the third day of June, in alternate rows, with seed taken from the large ends, middles, and tips, of the ears. It was hoed three times in the course of the season. One acre was harvested and husked with care, and the result noted on the 19th of October. The rows planted with seed taken from the large ends of the ears produced seven hundred and thirty-eight pounds of sound and seventy-seven pounds of soft corn on the ear, and one thousand three hundred and sixty pounds of stover. That from seed taken from the middle of the ears produced six hundred and sixty-three pounds of sound corn in the ear, one hundred and sixty-four pounds of soft corn, and one thousand two hundred and ninety ponnds of stover. That from seed taken from the small ends produced seven hundred and forty-seven pounds of sound and fifty-three pounds of soft corn, and one thousand three hundred and twenty pounds of stover. Comparing the crops grown on this acre, and estimating the sound corn at one, and the soft corn at half a cent per pound, and the stover at seven dollars the ton,—which is about its market value in that vicinity,—it would appear that the value of the crop the seed for which was taken from the large ends of the ear was as follows:

738	pounds of	sound corn,	@ 1 cent per pound,	$7.38
77	"	soft corn,	@ ½ " " "	.39
1360	"	stover,	@ 7 dollars per ton,	4.76
				$12.53

Value of the product of the rows planted with seed taken from the middle of the ears:

663	pounds	sound corn,	$6.63
164	"	soft corn,	.82
1200	"	stover, @ 7 dollars per ton,	4.51
			$11.96

Value of the product of the rows planted with seed taken from the tips of the ears:

747	pounds	sound corn,	$7.47
53	"	soft corn,	.27
1320	"	stover,	4 62
			$12.36

In this case, the seed from the butts produced the most, that from the tips the next, and that from the middles the least, in money value; but the tips produced the most, the butts the next, and the middles the least, sound corn; while the middles produced the most, the butts the next, and the tips the least, soft corn.

One experiment, as already intimated, does not prove a point in agriculture, however fair it may be,—and the above was eminently so, so far as uniformity of soil and manuring was concerned,—and this point is worthy of more careful trial and investigation by practical farmers.

The chief objection to sowing Indian corn to be cut up green and dried for winter fodder is to be found in the difficulty with which it is cured, on account of the lateness of the season at which it arrives at the most productive stage of its growth, and the extreme succulency of its large and juicy leaves. But when properly cured it affords a very large amount of nutritious feed, which is relished by all kinds of stock, and is especially valuable for feeding to young animals; and, notwithstanding the objection often made to it, it is

worthy of a more extended cultivation for this purpose.

The amount of dried fodder which may be obtained from it, when properly cultivated, is truly astonishing. Perhaps the process of kiln-drying might be introduced with advantage. It is, at least, worthy of a careful trial, wherever facilities for it can be had at a reasonable expense.

CHAPTER III.

THE ARTIFICIAL GRASSES; OR, PLANTS CULTIVATED AND USED LIKE GRASSES, THOUGH NOT BELONGING TO THE GRASS FAMILY.

We have given our whole attention, in the preceding pages, to what are strictly and properly called the natural or the true grasses. We now come to consider, very briefly, another class of plants, called artificial grasses.

Curious as it may appear, the artificial grasses were cultivated first, in point of time, in England; the red clover having been introduced and grown there about the year 1633; sainfoin, 1651; yellow clover in 1659, and white clover about the year 1700; while not one of the natural grasses was cultivated till nearly a century later, with the exception of perennial rye grass, first cultivated in 1677.

About the year 1759 the custom of sowing the chaff and seed dropped from the hay-stack along with the artificial grasses and rye grass began, and soon after, — between 1761 and 1764, — the cultivation of Timothy and orchard grass was introduced from America. The culture of the bent grasses, the sheep's fescue, and the crested dog's tail, began soon after. In 1766 the London Society for the Encouragement of Arts offered premiums for the collection of the seeds of some of the grasses then found growing wild, such as the meadow foxtail, the meadow fescue, the sweet-scented vernal

grass, &c.; and in 1769 the same society offered additional rewards for further investigations and experiments on the culture and comparative value of the natural grasses. But little was done, however, till the experiments at Woburn Abbey, in 1824.

In this country the extensive and practical cultivation of the natural grasses seems to have been commenced at an earlier date than in England; for Jared Eliot, writing about the year 1750, speaks of the culture of Timothy as having been adopted some time previously. Indeed, the necessities of our rigorous climate compelled attention to this branch of husbandry soon after the establishment of the Plymouth colony, in the year 1620.

The climate of England, on the other hand, admitted a greater degree of reliance on the wild luxuriance of nature, while the culture of the grains gave a sufficiency of coarse straw, which formed the winter sustenance for stock till the modern improvements in farming introduced a better system. This mode of management was brought over to this country by the first settlers, and attempted for some time; the few cattle they had being kept on poor and miserable swale hay, or often upon the hay obtained from the salt marshes. The death of their cattle from starvation and exposure was of very common occurrence, and not unfrequently the farmer lost his entire herd. The treatment of animals now as they were treated during the whole of the first century of the colony, would be an evidence of inhumanity which could scarcely be tolerated in any community. This treatment was in part, at least, owing to the poverty of the settlers, and more, probably, to the ideas and practices in which they had been early trained in a different climate. Fortunately for the most useful of our domestic animals, a more enlightened pol-

icy now governs the mass of men, and this policy has led to greater care and attention to the cultivation of the grasses.

The culture of the natural grasses takes the precedence, therefore, in this country, in point of time, from the causes already indicated; but the minds of men are so influenced by the routine of ordinary practice, that the introduction of clover in the early part of the last century met with great prejudice, which is now nearly, if not quite extinct.

Red Clover (*Trifolium pratense*), though not included in the family of grasses, is not only extensively cultivated, but is found to be one of the most valuable and economical forage plants. It belongs to the pulse family, or *Leguminosæ*, which includes the larger portion of forage plants called artificial grasses, in distinction from the gramineæ, the only true, and often called the natural grasses. The generic name, trefoil, or trifolium, is derived from the Latin *tres*, three, and *folium*, a leaf; and the genus can generally be very readily distinguished by the number and arrangement of its leaves in three leaflets, and flowers in dense oblong or globular heads.

The stems of red clover are ascending, somewhat hairy; leaflets oval or obovate, often notched at the end, and marked on the upper side with a pale spot; heads ovate, and set directly upon the stalk, instead of upon branches. This species is regarded as by far the most important of the whole genus for the practical purposes of agriculture. It has passed into a number of varieties, one of which is biennial, another perennial; the latter by long cultivation becoming biennial, while the former — as is true of most biennial, and many annual plants — assumes, to some extent, the

character of a perennial, and can be made to last three or four years, or even more, by simply preventing it from running to seed. This plant is seen in Fig. 147, its leaf is shown in Fig. 148, and its fruit magnified in Fig. 149.

Fig. 147. Red Clover.

Fig. 149.

Fig 148.

The introduction of clover into England, it is often said, produced an entire revolution in her agriculture; and, indeed, when we consider how important a part it plays in our own system of farming, we can with difficulty imagine how our ancestors ever got on at all in farming without it. Be this as it may, it is certain that it led to many of the most important improvements in the rotation of crops. Clover is very properly regarded as a fertilizer of the soil. The action of its long and powerful tap-roots is not only mechanical, — loosening the soil, and admitting the air, — but also chemical, serv-

ing to fix the gases important to enrich the earth, and when these roots decay they add largely to that black mass of matter we call the soil. It serves, also, by its luxuriant foliage, to destroy annual weeds which would spring up on newly-seeded land, especially after imperfect cultivation. But one of the most valuable uses of it, and one too often overlooked, is to shade the surface of the soil, and thereby increase its fertility.

Clover is emphatically a lime plant, and the soils best adapted to it are tenacious or stiff loams. The careful analysis of Professor Way found no less than 35.39 per cent. of lime in the inorganic constituents of red clover, and that of Boussingault 32.80 per cent., while intelligent practice has arrived so nearly at the same conclusion, that the term "clover soils" is now almost universally used to indicate a tenacious loam, containing more or less of lime or clay in its composition.

Another great advantage in favor of the cultivation of clover, consists in its rapid growth. But a few months elapse from the sowing of the seed before it yields, ordinarily, an abundant and nutritious crop, relished by cattle of all kinds.

Clover-seed should always be sown in the spring of the year, in the climate of New England. It is often sown upon the late snows of March or April, and soon finds its way down to the soil, where, aided by the moisture of early spring, it quickly germinates, and rapidly shoots up its leaf-stalks.

An accurate and valuable analysis of this plant, both in its green and dry state, will be found in a tabular form on a subsequent page; while a more extended notice of its culture and the mode of curing it, with the results of practical experience as to its value, will also be given in its proper place.

White Clover, Dutch Clover, Honeysuckle (*Trifolium repens*), is equally common with the red, and often forms a very considerable portion of the sward or turf of pastures and fields of a tenacious and moist soil. Its stems are spreading, slender, and creeping;

Fig. 150. White Clover.

Fig. 151.

leaves inversely heart-shaped; flower-heads small, white; pods four-seeded; root perennial. Flowers from May to September. This plant is shown in Fig. 150. A magnified flower is seen in Fig. 151.

White clover is widely diffused over this country and all the countries of Europe. It is indigenous probably both to England and America. When first cultivated from seed collected from wild plants, at the beginning of the last century, it was recorded of a farmer that he had "sowed the wild white clover which holds the ground and decays not." Its chief value is as a pasture grass, and it is as valuable for that purpose as the red clover is for hay or for soiling, though there are some who place a low estimate upon it.

It easily accommodates itself to a great variety of soils, but grows most luxuriantly in moist grounds and moist or wet seasons. Indeed, it depends so much upon a general distribution of rains through the season, that when they are sufficiently abundant it comes in

profusely even where it was not observed in other years, and hence such seasons pass under the term of "clover years." It is not, apparently, so much relished by stock as from its sweetness we should be led to expect; but it is, on the whole, to be cherished for permanent pastures, and improved, as it undoubtedly may be, by a proper selection and culture of varieties. For an accurate analysis of this plant, the reader is referred to a subsequent page.

COW GRASS, ZIGZAG CLOVER, PERENNIAL CLOVER (*Trifolium medium*), grows on dry hills in Massachusetts, and has been introduced for cultivation in various parts of the country, as a pasture plant. Its stems are zigzag, smoothish; leaflets oblong, entire, spotless; heads mostly stalked; flower purple, and larger than in red clover.

ALSIKE, or SWEDISH CLOVER (*Trifolium hybridum*), has also been introduced for cultivation on moist, strong soils, and is found to be a valuable acquisition. It will continue in the soil for many years, from its own seeds, if left to mature.

SUCKLING RED CLOVER (*Trifolium filiforme*) has also been introduced and recommended for cultivation, but has not come into general culture.

LUCERNE, ALFALFA (*Medicago sativa*), is shown in Fig. 152. Leguminous plants of the genus *Medicago* have been known and cultivated from time immemorial. This particular species, lucerne, was brought from Media to Greece, in the time of Darius, about five hundred years before Christ, and its cultivation afterwards extended among the Romans, and through them to the south of France, where it has ever since continued to be a favorite forage plant. It does not endure a climate as severe as red clover, requiring greater heat and sun-

light; but, in a latitude equally suited to both plants, it would, perhaps, be somewhat difficult to say which should have the preference. In some respects it is decidedly superior, as in being perennial, and consequently remaining long in the soil. I have seen fine specimens of it, where the seed was sown in 1824, still maintaining its vigorous hold of the soil, and growing with remarkable luxuriance. The crop of lucerne is as abundant as red clover, and is equally well relished by cattle, both green and dry. Its yield of green fodder continues later in the season than that of red clover.

Fig. 152. Lucerne.

Fig. 154.

Fig. 153.

Lucerne sends down its tap roots in mellow soils to enormous depths, having been found in sandy soils thirteen feet in length. The leaflets are in threes, obovate,

oblong, toothed; the flowers pale-blue, violet, or purple, shaped as in Fig. 153; the fruit in downy pods, having two or three twirls, as in Fig. 154.

Lucerne is cultivated in Chili, and grows wild in the utmost luxuriance in the pampas of Buenos Ayres, where it is called alfalfa, which is simply the common lucerne, slightly modified by climate, and may be regarded as a variety.

The cultivation of lucerne is somewhat more difficult than that of clover for the first year, requiring a soil thoroughly mellowed, and prepared by clean and careful tillage; and the want of proper attention on this point has led to partial failures in the attempts to raise it in this country. It suffers and languishes in compact clay soils, and does not flourish in light soils lying over an impermeable subsoil, which prevents the water from running off. It will never succeed well on thin soils. But in a permeable subsoil, consisting of loam, or sand, or gravel, its roots can penetrate to great depths; and, being nearly destitute of lateral shoots, provided with numerous fibrous rootlets, or radical off-shoots, imbibe their moisture and nutriment in layers of soil far below the average of other plants. In this respect it differs materially from clover.

For lucerne, a suitable subsoil is of the utmost consequence. For the short-lived red clover, a suitable surface soil is more important; a want of care and deep tillage, especially a neglect to break through and loosen up the hard-pan wherever it exists, will inevitably lead to failure with lucerne. But, when the soil is suitable, it will produce good and very profitable crops for from five to ten or twelve years, and, of course, it does not belong in the system of short rotations.

But, notwithstanding the large quantity of succulent and nutritious forage it produces, its effect is to ameli-

orate and improve the soil, rather than to exhaust it. This apparent anomaly is explained by the fact that all leguminous, broad-leaved plants derive a large proportion of their nutritive materials from the atmosphere, and that a vast quantity of roots are left to decay in the soil when it is at last broken up, varying, of course, with the length of time the plant continues in the soil, while the luxuriant foliage serves to shade the soil, and thus to increase its fertility. Much of this rich foliage is scattered and left to decay, as is the case with all similar plants at the time of harvesting, and the growth of the aftermath is also usually very considerable. The fact that it actually increases the fertility of the soil for other plants has often been proved, and may be regarded as fully established. A soil which would bear only a medium crop of wheat at first, produced a greatly increased quantity after being laid down to lucerne a few years, till its roots had enriched the soil.

Lucerne should not follow immediately after having been grown a few years on the same soil, and then broken up; but after the land on which it has been grown has been cultivated with some other crop, or laid down to the natural grasses a length of time equal to that during which it had previously remained in lucerne, it can safely be sown again with it.

The seed of lucerne, when fresh and good, is yellow, glossy, and heavy. If the seeds are white, it is an indication that they are not ripe. If they are brown, we may infer that they have been subjected to too strong a heat to separate them from their husks. In either of these cases, it is not safe to purchase or to rely upon them. The same may be said of clover, and it is desirable to try them by a simple method, which will be indicated hereafter in speaking of the selection of seed. As the seeds of lucerne are somewhat larger than

clover-seed, and the plant tillers less, it is necessary to sow a larger quantity per acre. It may be sown in the spring along with grain crops, as clover often is, and not a very large crop should be expected the first year.

Lucerne should be cut as soon as it begins to flower, or even earlier. If cut much earlier, it is apt to be too watery and less nutritious, and cures with greater difficulty; if later, it becomes coarse and hard, with woody fibre, and is less relished by cattle. It may be cut and fed green, and is an exceedingly valuable plant for soiling cattle, or it may be cut and cured and used like clover hay; but in either case it must be cut before blossoming.

It is thought by many that lucerne will not endure our northern climates; but I do not think it satisfactorily proved, and I have been somewhat minute in speaking of it, in the hope of inducing more careful experiments on a scale and under circumstances sufficient to determine its relative value for us. I am the more anxious on this point from the fact that I am convinced, after much study and observation of our climate, that we should direct our labors in farming more with reference to the frequent droughts of summer to which we are liable every year, and from which there is no immediate and practicable escape, except in thorough drainage and deep tillage, which most farmers are unwilling to undertake at present. "When properly managed, the number of cattle which can be kept in good condition on an acre of lucerne, during the whole season, exceeds belief. It is no sooner mown than it pushes out fresh shoots; and, wonderful as the growth of clover sometimes is, in a field that has been lately mown, that of lucerne is far more rapid. Lucerne will last for many years, shooting its roots—tough and

fibrous almost as those of liquorice — downwards for nourishment, till they are altogether out of the reach of drought. In the dryest and most sultry weather, when every blade of grass droops for want of moisture, lucerne holds up its stem, fresh and green, as in the genial spring."

I am convinced, also, that the failures of attempts to cultivate lucerne with us may be ascribed, in very many instances, to an improper selection of soils; but it is nevertheless true that our climate is not so well adapted to it as that of the south of France; and experiments hereafter, like those already made, may show its culture to be wholly impracticable.

SAINFOIN (*Hedysarum onobrychis*) differs from lucerne in many important particulars. It is a leguminous plant, with many stems from two to three feet long, straggling, tapering, smooth; leaves in pairs of pointed, oblong leaflets, slightly hairy on the under side; flower-stalks higher than the leaves, ending in a spike of crimson or variegated flowers, succeeded by flat, hard pods, toothed on the edges and prickly on the sides; root perennial and hard and woody. Flowers in July. It is shown in Fig. 155. The flower is shown in Fig. 156, and the fruit in Fig. 157.

Experiments have been made in introducing and cultivating it in the northern latitudes of this country, but without much success. It requires a calcareous soil. In the south of France, where it flourishes best, it is considered an indispensable forage plant, improving the quality and increasing the quantity of milk when fed to milch cows, to which it may be given without producing the "hoove," to which they are subjected when allowed to feed freely on green clover and lucerne. Its stalks do not become ligneous if allowed to stand till

blossoming, as those of lucerne do. The amount of fodder obtained from it is less than that from clover or lucerne, but its quality, where it can be successfully grown, is better. Its fruit or seeds are said to be more nutritious than oats. They are eagerly sought by fowls, and are said to cause them to lay.

Fig. 155. Sainfoin.

Fig. 157.

Fig. 156.

Sainfoin, when green and young, will not stand a severe winter, but after the second or third year will endure a considerable degree of cold. It will succeed in very dry soils, sands, and gravels, owing to its long descending tap root, which has been found sixteen feet in length. Its seeds have been generally distributed over the country, but, so far as I know, they have been followed by no marked success in the way of crops.

JAPAN CLOVER (*Lespedeza striata*). This plant, supposed to have been introduced from Japan about

Fig. 157*a*. Japan Clover.

forty years ago, has assumed very considerable importance over a large portion of the Southern States as a valuable forage plant. It belongs to the leguminous family. The leaves are trifoliate, the flowers pea-shaped and purplish, the seed-pods small, oval, each holding a single seed. It has spread rapidly and widely, till it may now be said to extend from the Atlantic to Western Texas, adapting itself to nearly all soils and locations. On cultivated lands of good quality it grows erect and much branched, and furnishes a very valuable hay. On light sands and gravels it maintains its dwarfish habit, with a wiry growth like the knot-grass; but on richer soils it rises to two or three feet and is often called "bush-clover." It sends a long tap-root down into the sub-soil, and that enables it to endure a drought. Stock of all kinds are very fond of it, and it is valuable for grazing as well as for hay.

It is usually sown broadcast at the rate of half a bushel of seed to the acre, and does well sown with grain.

CHAPTER IV.

THE GRASS-LIKE RUSHES, CARICES, AND SEDGES COMMONLY CALLED GRASSES.

There is a large class of plants belonging to different families, which, though of comparatively little value when their nutritive qualities are considered, are nevertheless used as forage crops to a very considerable extent in different sections of the country, and demand at least a passing notice, particularly as they are called grasses, though improperly, in popular language.

The first of these are the arrow grasses, which form a limited family, consisting of only three species, known as the Marsh Arrow Grass (*Triglochin palustre*), the Sea-side Arrow Grass (*Triglochin maritimum*), flowering in July and August, in salt marshes, and the Tall Arrow Grass (*Triglochin elatum*). The second of these, having rush-like leaves, sweetish to the taste, is relished by cattle, and forms a pretty good fodder when well cured. It is common along the coast from New England south.

Many of the rushes or grass-like plants so common along the borders of our ponds, and called grasses in popular language, are readily eaten in the spring while green and full of juice, more on account of their succulency than of any nutritive qualities which they possess, which, with few exceptions, are very slight. They are arranged in the following table:

TABLE II.—LIST OF GRASS-LIKE RUSHES. (*Juncaceæ.*)

Common Name.	Systematic Name.	Time of Flowering.	Place of Growth.
Hairy Wood Rush, . .	Luzula pilosa, ...	May, . . .	Open woods, banks.
Small Wood Rush, . .	Luzula parviflora, . . .	July, . . .	Mountains.
Common Wood Rush, .	Luzula campestris, . .	May, . . .	Fields, dry woods.
Pointed Rush, ...	Luzula arcuata, ...	—	Mountains.
Brown Rush, ...	Luzula spicata, ...	—	Mountains.
Soft Rush, ...	Juncus effusus, ...	June, . . .	Swamps, common.
Slender Rush, ...	Juncus filiformis, . . .	July, . . .	Wet banks.
Baltic Rush, ...	Juncus balticus, ...	July, . . .	Sandy shores.
Bristly Rush, ...	Juncus setaceus, . . .	—	On the coast.
Sea Rush, ...	Juncus maritimus, . .	—	Salt marshes.
Pale Rush, ...	Juncus scirpoides, . . .	—	Wet banks.
Green Rush, ...	Juncus paradoxns, . .	July, . . .	Swamps.
Weak Rush, ...	Juncus debilis, ...	—	Wet swamps.
Sharp-fruited Rush, . .	Juncus acuminatus, . .	August, . .	Boggy swamps.
Brownish-fruited Rush, .	Juncus articulatus, . .	—	Wet places.
Marshal Rush, ...	Juncus militaris, . . .	—	Sandy bogs.
Round-headed Rush, .	Juncus nodosus, ...	July, . . .	Borders of rivers.
Conrad's Rush, ...	Juncus Conradi, . . .	July, Aug.,	Borders of ponds.
Grass-leaved Rush, . .	Juncus marginatus, . .	July, . . .	Moist, sandy swamps.
Long-fruited Rush, . .	Juncus Stygius, ...	—	Peat swamps.
Three-leaved Rush, . .	Juncus trifidus, ...	July, . . .	Mountain summits.
Toad Rush, ...	Juncus bufonius, . . .	July, . . .	Low grounds, roadsides.
Slender Rush, ...	Juncus tenuis, ...	July, . . .	Low grounds, fields.
Greene's Rush, ...	Juncus Greenei, ...	July, . . .	Sandy salt marshes.
Black Grass, ...	Juncus bulbosus, . . .	August, . .	Borders salt marshes.

The most prominent and valuable of these plants is the

BLACK GRASS (*Juncus bulbosus*, var. *gerardi*), an inhabitant of salt marshes. This plant has a simple, slender stem, somewhat flattened, from one to two feet high. It is considered the best product of the salt marshes, and grows most luxuriantly along their borders, which are only occasionally overflowed by the tides, often working its way to the uplands, where the seed is scattered, in large quantities, in curing. It should be cut early, and, when well cured, is thought to be nearly equal in value to good English hay. Though not of itself equal in value, weight for weight, to "goose

grass" (*Glyceria maritima*), yet the product per acre is so much larger as to make it a more desirable crop.

There is also a small family of plants called the yellow-eyed grasses, or the star grasses, consisting of only two species, the first of which is the YELLOW-EYED GRASS (*Xyris bulbosa*), flowering in July, August, and September, growing on sandy and peaty soils, and bogs near the coast; and the second, the COMMON YELLOW-EYED GRASS (*Xyris caroliniana*), flowering in August, on sandy swamps. These are beautiful grasses, but of no special agricultural value.

The sedges and plants constituting the coarse and innutritious herbage, properly included in the term CAREX, form a large and prominent genus of grass-like plants, consisting in all of about four hundred and fifty species, known to botanists, extensively diffused over all the damp parts of the globe, and in popular language called grasses.

The roots of the sedges are perennial, and for the most part creeping, a few being tufted and fibrous. The stems are simple and free from joints or nodes. The leaves are linear, flat, pointed, roughish on the surface, and sharp on the edges.

A few species of carex grow on sandy hills and along the sea-shore; but most inhabit marshes, wet meadows, swamps, and the low, wet banks of streams and ditches, and moist woods. None of them are of any real agricultural value, though they constitute mainly what is termed "meadow hay," or more properly swale hay, in some parts of the country. They are nearly destitute of mealy and saccharine principles, in which many of the true grasses abound, and are eaten by cattle only when compelled by hunger, in the want of better grasses. It not unfrequently happens, however, that

there is an admixture of the higher grasses among the carices or sedges, such as the fowl meadow, the bastard fowl meadow, the white top, or some of the other species possessing higher nutritive qualities; and then, of course, the hay made from the swale is proportionably improved, and may thus become of considerable value for winter fodder.

The sedges are arranged in the following table:

TABLE III.—LIST OF CARICES OR SEDGES. (*Cyperaceæ.*)

Common Name.	Systematic Name.	Time of Blossoming.	Place of Growth.
Yellow Dwarf Sedge, . .	Cyperus flavescens, . .	Aug., . . .	Bogs.
Diandrus Sedge, ...	Cyperus diandrus, . . .	Aug., . . .	Wet grounds.
Nuttall's Sedge, ...	Cyperus Nuttallii, . . .	Aug., . . .	Salt marshes.
Brown Sedge, ...	Cyperus flavicomus, . .	Aug., . . .	Low grounds.
Chestnut Sedge, ...	Cyperus erythrorhizos, .	Aug., . . .	Sandy banks.
Michaux's Sedge, . . .	Cyperus Michauxianus,	Aug., . . .	Marshes.
Engelmann's Sedge, . .	Cyperus Engelmanni, .	—	Low banks.
Bristle-spiked Galingale,	Cyperus strigosus, . . .	Aug., . . .	Swamps.
Dwarf Odorous Galingale,	Cyperus inflexus, . . .	Aug., . . .	River banks.
Pointed Sedge, ...	Cyperus acuminatus, .	—	Low grounds.
Green Sedge, ...	Cyperus virens, ...	—	Wet places.
Toothed Galingale, . .	Cyperus dentatus, . . .	Aug , . . .	Sandy swamps.
Nut Grass, ...	Cyperus rotundus, . .	—	Sandy fields.
Gray's Galingale, . . .	Cyperus Grayii, ...	Aug., . . .	Barren soils.
Straw Sedge, ...	Cyperus phymatodes, .	Aug., . . .	Along rivers.
Schweinitz's Galingale, .	Cyperus Schweinitzii, .	Aug., . . .	Shores of lakes.
Ovate Sedge, ...	Cyperus ovularis, . . .	Sept., . . .	Sandy soils.
Bent Sedge, ...	Cyperus retrofractus, .	Aug., . . .	Sandy soils.
Wiry Sedge, ...	Cyperus filiculmis, . .	Aug., . . .	Dry barrens.
Roundhead Sedge, . . .	Kyllingia pumila, . . .	Aug., . . .	Low grounds.
Dulichium, ...	Dulichium spathaceum,	Aug., . . .	Around ponds.
Dwarf Hemicarpha, . .	Hemicarpha subsquarrosa, ...	July, . . .	Wet sands.
Horsetail Rush, ...	Eleocharis equisetoides,	—	Shallow water.
Quadrangular Rush, . .	Eleocharis quadrangulata, ...	—	Low grounds.
Tubercled Spike-rush, .	Eleocharis tuberculosa,	Aug , . . .	Sandy swamps.
Obtuse Spike-rush, . .	Eleocharis obtusa, . . .	June, . .	Bogs, borders of ponds.
Common Spike-rush, . .	Eleocharis palustris, . .	Aug., . . .	Swamps.
Olive Spike-rush, . . .	Eleocharis olivacea, . .	Aug., . . .	Wet, sandy places.
Brake Spike-rush, . .	Eleocharis rostellata, . .	—	Marshes.
Mediate Spike-rush, . .	Eleocharis intermedia, .	Aug., . . .	Wet places.
Slender Club-rush, . .	Eleocharis tenuis, . . .	June, . . .	Wet places.

Common Name.	Systematic Name.	Time of Blossoming.	Place of Growth.
Tufted Rush, ...	Eleocharis compressa, .	—	Wet places.
Black Club-rush, . . .	Eleocharis Melanocarpa,	—	Wet sands.
Flat Stem-rush, ...	Eleocharis tricostata, . .	—	
Robbins's Club-rush, . .	Eleocharis Robbinsii, .	July, . . .	Ponds, ditches.
Hair Club-rush, ...	Eleocharis acicularis, .	June, . . .	Muddy banks.
Dwarf Spike-rush, . . .	Eleocharis pygmæa, . .	Aug., . . .	Salt marshes.
Threadlike Rush, . . .	Eleocharis filiculmis, . .	—	Wet barrens.
Scaly Club-rush, . . .	Scirpus cæspitosus, . .	July, . . .	Wet mountains.
Flat Club-rush, ...	Scirpus planifolius, . .	June, . . .	Woods, bogs.
Floating Club-rush, . .	Scirpus subterminalis, .	Aug., . . .	Sluggish streams.
Chair-bottom Rush, . .	Scirpus pungens, . . .	July, . . .	Salt and fresh marshes.
Olney's Rush, ...	Scirpus Olneyi, ...	July, . . .	Salt marshes.
Torrey's Rush, ...	Scirpus Torreyi, ...	July, . . .	Borders of ponds.
Bulrush, ...	Scirpus lacustris, . . .	July, . . .	Muddy places.
Weak-stem Rush, . . .	Scirpus debilis, ...	Aug., . . .	Borders of rivers.
Sea Bulrush, ...	Scirpus maritimus, . .	Aug., . . .	Salt marshes.
River Rush, ...	Scirpus fluviatilis, . . .	July, . . .	Borders of lakes.
Wood Rush, ...	Scirpus sylvaticus, . .	July, . . .	Wet meadows.
Cluster-head Rush, . .	Scirpus polyphyllus, . .	July, . . .	Swamps, shady borders.
Porter's Rush, ...	Scirpus lineatus, . . .	July, . . .	Bogs.
Wool Grass, ...	Scirpus Eriophorum, . .	Aug., . . .	Wet meadows, swamps.
Cotton Grass, ...	Eriophorum Alpinum, .	May, . . .	Peat swamps.
Hare's-tail, ...	Eriophorum vaginatum,	June, . . .	Mossy swamps.
Rusty Cotton Grass, . .	Eriophorum Virginicum,	July, . . .	Swamps.
Broad Cotton Grass, . .	Eriophorum polystachyon, ...	June, . . .	Boggy meadows.
Narrow Cotton Grass, .	Eriophorum gracile, . .	July, . . .	Mossy swamps.
Tall Fimbristylis, . . .	Fimbristylis spadicea, .	Aug., . . .	Salt marshes.
Spreading Fimbristylis,	Fimbristylis laxa, . . .	Aug., . . .	Wet clays.
Tufted Fimbristylis, . .	Fimbristylis autumalis, .	Sept., . . .	Low grounds.
Hair-like Fimbristylis, .	Fimbristylis capillaris, .	Aug., . . .	Sandy fields.
Umbrella Grass, . . .	Fuirena squarrosa, . .	Aug., . . .	Sandy, wet places.
Bald Rush, ...	Psilocarya scirpoides, .	July, . . .	Inundated swamps.
Dichomena, ...	Dichomena leucocephala,	Aug., . . .	Moist barrens.
Horned Rush, ...	Ceratoschœnus corniculata, ...	—	Borders of ponds.
Clustered Rush, ...	Ceratoschœnus macrostachya, ...	—	Borders of ponds.
Wrinkled Beak-rush, .	Rhynchospora cymosa, .	—	Low grounds.
Torrey's Beak-rush, . .	RhynchosporaTorreyana,	—	Pine barrens.
Drooping Beak-rush, . .	Rhynchospora inexpansa,	—	Low grounds.
Brown Beak-rush, . . .	Rhynchospora fusca, . .	July, . . .	Low grounds.
Slender Beak-rush, . .	Rhynchosporagracilenta,	—	Low grounds.
White Beak-rush, . . .	Rhynchospora alba, . .	July, . . .	Mossy swamps.
Small Beak-rush, . . .	Rhynchospora capillacea,	July, . . .	Swamps, marshes.
Tufted Beak-rush, . . .	Rhynchospora Knieskernii, ...	—	Bog, iron-ore banks.
Common Beak-rush, . .	Rhynchosporaglomerata,	July, . . .	Boggy grounds.

Common Name.	Systematic Name.	Time of Blossoming.	Place of Growth.
Round Beak-rush, . . .	Rhynchospora cephalantha, ...	Aug., . . .	Sandy swamps.
Smooth Twig-rush, . .	Cladium mariscoides, .	July, . . .	Borders of ponds.
Whip Grass, ...	Scleria triglomerata, . .	July, . . .	Swamps, moist thickets.
Sessile Nut-rush, . . .	Scleria reticularis, . . .	Aug., . . .	Sandy swamps.
Loose Nut-rush, ...	Scleria laxa, ...	Aug., . . .	Sandy swamps.
Few-flowered Nut-rush,	Scleria pauciflora, . . .	July, . . .	Swamps, hills.
Dwarf Nut-rush, . . .	Scleria verticillata, . . .	June, . . .	Swamps.
Short-beaked Sedge, . .	Carex gynocrates, . . .	—	Swamps.
Slender Sedge, ...	Carex exilis, ...	June, . . .	Marshes.
Alpine Sedge, ...	Carex scirpoidea, . . .	—	Mountain tops.
Small-head Sedge, . . .	Carex capitata, ...	July, . . .	Mountain tops.
Few-flowered Sedge, . .	Carex pauciflora, . . .	—	Peat swamps.
Bristle-stalked Sedge, .	Carex polytrichoides, .	May, . . .	Low ground, woods.
Frazer's Sedge, ...	Carex Fraseriana, . . .	—	Rich woods.
Willdenow's Sedge, . .	Carex Willdenovii, . .	May, . . .	Moist, shady places.
Rough-beak Sedge, . .	Carex stendelii, ...	—	Woody hills.
Back's Sedge, ...	Carex Backii, ...	—	Rocky hills.
Two-seeded Sedge, . . .	Carex disperma, . . .	June, . . .	Mossy swamps.
Long-rooted Sedge, . .	Carex chordorhiza, . .	May, . . .	Mossy swamps.
Oval-headed Sedge, . .	Carex cephalophora, . .	May, . . .	Hill-sides and fields.
Muhlenberg's Sedge, . .	Carex Muhlenbergii, . .	April, . . .	Rocky hill-sides.
Dry-spiked Sedge, . . .	Carex sicata, ...	—	Sandy plains.
Rose Sedge, ...	Carex rosea, ...	May, . . .	Moist woods.
Retroflexed Sedge, . .	Carex retroflexa, . . .	May, . . .	Open woods, swamps.
Bur-reed Sedge, ...	Carex sparganioides, .	May, . . .	Low, swampy grounds.
Awl-fruited Sedge, . .	Carex stipata, ...	April, . . .	Swamps, low grounds.
Fox Sedge, ...	Carex vulpinoidea, . .	May, . . .	Low grounds, common.
Bristly-spiked Sedge, .	Carex setacea, ...	June, . . .	Wet meadows.
Bromus-like Sedge, . .	Carex bromoides, . . .	May, . . .	Wet swamps.
Foxtail Sedge, ...	Carex alopecoidea, . .	—	Woods.
Sartwell's Sedge, . . .	Carex Sartwellii, . . .	—	
Lesser-panicled Sedge, .	Carex teretiuscula, . .	June, . . .	Swamps, common.
Large-panicled Sedge, .	Carex decomposita, . .	—	Swamps.
Three-seeded Sedge, . .	Carex trisperma, . . .	June, . . .	Peat swamps.
Dewey's Sedge, ...	Carex Deweyana, . . .	June, . . .	Moist woods.
White Carex, ...	Carex canescens, . . .	May, . . .	Wet meadows.
Little Prickly Sedge, . .	Carex stellulata, . . .	May, . . .	Wet meadows.
Cluster-spiked Sedge, .	Carex tenuiflora, . . .	June, . . .	Mossy swamps.
Broom-like Sedge, . . .	Carex scoparia, ...	—	Wet meadows.
Straw-colored Sedge, . .	Carex straminea, . . .	May, . . .	Borders of woods.
Long-stalked Sedge, . .	Carex pedunculata, . .	April, . . .	Rocky hills.
Square-headed Sedge, .	Carex squarrosa, . . .	May, . . .	Low meadows, thickets.
Buxbaum's Sedge, . . .	Carex Buxbaumii, . . .	May, . . .	Mossy swamps.
Three-headed Sedge, .	Carex triceps, ...	May, . . .	Woods, meadows.
Green-spiked Sedge, . .	Carex virescens, . . .	May, . . .	Woods, hill-sides.
Slender Nodding Sedge,	Carex gracillima, . . .	June, . . .	Moist grounds.
Showy Sedge, ...	Carex formosa, ...	May, . . .	Wet meadows.
Davis's Sedge, ...	Carex Davisii, ...	May, . . .	Swamps, river banks.

Common Name.	Systematic Name.	Time of Blossoming.	Place of Growth.
Rigid Sedge, ...	Carex rigida, ...	July, . . .	Mountain summits.
Large Bog Sedge, . . .	Carex augustata, . . .	May, . . .	Swamps, common.
Smaller Bog Sedge, . .	Carex cæspitosa, . . .	May, . . .	Swamps, river banks.
Water Sedge, ...	Carex aquatilis, ...	June, . . .	Borders of lakes.
Golden-fruited Sedge, . .	Carex aurea, ...	May, . . .	Borders of swamps.
Fringed Sedge, ...	Carex crinita, ...	May, . . .	Swamps, river banks.
Few-fruited Sedge, . .	Carex oligosperma, . .	June, . . .	Mountains, swamps.
Inflated Sedge, ...	Carex bullata, ...	May, . . .	Swamps.
Cylindrical-spiked Sedge,	Carex cylindrica, . . .	—	Swamps.
Bladder-fruited Sedge, .	Carex utriculata, . . .	May, . . .	Wet swamps.
Awl-fruited Sedge, . . .	Carex subulata, ...	May, . . .	Cedar swamps.
Tall Yellow Sedge, . . .	Carex folliculata, . . .	June, . . .	Swamps, bogs.
Swollen-fruited Sedge, .	Carex intumescens, . .	June, . . .	Wet grounds.
Hop Sedge, ...	Carex lupulina, ...	June, . . .	Swamps.
Rough-fruited Sedge, .	Carex scabrata, ...	May, . . .	Borders of brooks.
Schweinitz's Sedge, . .	Carex Schweinitzii, . .	May, . . .	Swamps.
Late-fruited Sedge, . .	Carex retrorsa, ...	May, . . .	Borders of ponds.
Long-pointed Sedge, . .	Carex tentaculata, . . .	May, . . .	Swamps.
Porcupine Sedge, . . .	Carex hystricina, . . .	June, . . .	Swamps.
Cyperus-like Sedge, . .	Carex Pseudo-Cyperus,	June, . . .	Sw'ps, sluggish streams.
Long-beaked Sedge, . .	Carex longirostris, . .	June, . . .	Shady, rocky places.
Hairy-fruited Sedge, . .	Carex trichocarpa, . .	June, . . .	Marshes and lakes.
Awned Sedge, ...	Carex aristata, ...	—	Lake shores.
Umbel-spiked Sedge, .	Carex umbellata, . . .	May, . . .	Rocky hill-sides.
Pennsylvanian Sedge, .	Carex Pennsylvanica, .	April, . . .	Dry woods.
New England Sedge, . .	Carex Novæ-Angliæ, .	June, . . .	Woody hills.
Slender-leaved Sedge, .	Carex filiformis, ...	May, . . .	Peat swamps.
Woolly-fruited Sedge, .	Carex lanuginosa, . . .	May, . . .	Swamps.
Sh't Woolly-spik'd Sedge,	Carex vestita, ...	May, . . .	Moist, sandy soils.
Pubescent Sedge, . . .	Carex pubescens, . . .	May, . . .	Woods, swamps.
Mud Sedge, ...	Carex limosa, ...	June, . . .	Mossy swamps.
Livid Sedge, ...	Carex livida, ...	June, . . .	Mossy swamps.
Large Yellow Carex, . .	Carex flava, ...	May, . . .	Swamps.
Œder's Sedge, ...	Carex Œderi, ...	May, . . .	Limestone lands.
Pale Pubescent Sedge, .	Carex pallescens, . . .	May, . . .	Swamps.
Torrey's Sedge, ...	Carex Torreyi, ...	—	Northward.
Striated Sedge, ...	Carex striata, ...	May, . . .	Swamps.
Granular-spiked Sedge,	Carex granularis, . . .	May, . . .	Wet swamps.
Loose-flowered Sedge, .	Carex laxiflora, ...	May, . . .	Swamps, moist woods.
Conical-fruited Sedge, .	Carex conoidea, ...	May, . . .	Wet swamps.
Slender Wood Sedge, .	Carex digitalis, ...	May, . . .	Woods, hill-sides.
Hitchcock's Sedge, . .	Carex Hitchcockiana, .	May, . . .	Woods, hill-sides.
Small Few-fruited Sedge,	Carex oligocarpa, . . .	May, . . .	Woods.
Crooked-necked Sedge, .	Carex tetanica, ...	May, . . .	Margin of lakes.
Two-edged Sedge, . . .	Carex anceps, ...	May, . . .	Woods.
Pale, Smooth Sedge, . .	Carex blanda, ...	May, . . .	Swamps, open woods.
Crawe's Sedge, ...	Carex Crawei, ...	—	Banks of rivers.
Plantain-leaved Sedge, .	Carex plantaginea, . .	April, . . .	Shady, rocky ravines.
Carey's Sedge, ...	Carex Careyana, . . .	May, . . .	Shady, dry woods.

Common Name.	Systematic Name.	Time of Blossoming.	Place of Growth.
Bris'd-lea'd White Sedge,	Carex eburnea, ...	May, . . .	Limestone hills.
Fringed Sedge, ...	Carex flexilis, ...	June, . . .	Moist, shady places.
Sh't-beak'd Woody Sedge,	Carex arctata, ...	May, . . .	Woods, swamps.
Weak Sedge, ...	Carex debilis, ...	May, . . .	Woods, swamps.
Millet-like Sedge, . . .	Carex miliacea, ...	May, . . .	Wet swamps.
Lake Sedge, ...	Carex lucustris, ...	June, . . .	Deep swamps.
Tuckerman's Sedge, . .	Carex Tuckermani, . .	—	Wet swamps.
Washington's Sedge, . .	Carex Washingtoniana,	—	Mt. Washington.
Gray's Sedge, ...	Carex Grayii, ...	July, . . .	Swamps.
Bog Sedge, ...	Carex acuta, ...	—	Dense bogs.
Sea Carex, ...	Carex arenaria, ...	June, July,	Sandy sea-shores.

The above table includes nearly, if not quite, all the species of sedges known and described as growing in this country, and is thought to be very complete.

As already intimated, none of these coarse sedges are rich in nutritive elements, and none are worthy of cultivation. The farmer's care should be to eradicate them, and supply their places with the higher and more nutritious grasses. This may be done by thorough draining, an operation which lies at the foundation of all successful management of low lands, and without which they are comparatively worthless, while, if properly reclaimed, they are among the best and most productive lands on the farm.

When properly improved, and sown to the higher and better grasses, like Timothy, redtop, orchard grass, rough-stalked meadow, &c., they will produce the most luxuriant crops for several years in succession, often paying the cost of improvement the first year. Low grounds and swamps are the farmer's muck-beds. Thousands of acres of such lands now lie worthless and unproductive, waiting only to be reclaimed to add vastly to the material wealth of the country.

CHAPTER V.

VARIOUS CLASSIFICATIONS OF THE GRASSES.

Many of the grasses which have been described in the preceding chapters possess but little value for the purposes of cultivation, it is true, but it should not be forgotten that they all have their uses; and these uses in the grand economy of nature are exceedingly important, however they may appear to our short-sighted vision.

No plant comes up to the sunlight, or expands its beautiful leaves, that does not derive its support in part from the atmosphere; and, even though its life be short, it adds materially, in its decay, to the vast mass of vegetable mould which covers the surface of the globe, and forms the richness of the soil. This surface mould has been accumulating for ages in many localities; every plant that grew in ages past bringing down to us in a tangible form the riches with which the air that surrounded it was stored, which now lie waiting the farmers' use in meadows of exhaustless fertility, in swamps and bogs of vast, increasing utility in our agriculture, and in beds of peat, the value of which we have scarcely begun to appreciate. Thus, the grasses which are not cultivated for their direct nutritive qualities are not without their value, and they deserve our careful study and attention.

It is evident that various classifications of the grasses may be made, and that many species might be separated

into distinct groups, which would greatly facilitate the study of this family of plants; and this classification the reader can readily make, at his convenience. As an example, we have

I. The Bush or Jungle Grasses, or such as are not inclined to grow with other species, and form a close, matted turf or sward. Of these we have as examples the

Tufted Hair Grass (*Aira cæspitosa*).
Meadow Oat Grass (*Avena pratensis*).
Tall Fescue Grass (*Festuca elatior*).

A few others, if sown alone, will assume somewhat the same form, in tufts or cushions; as,

Sheep's Fescue (*Festuca ovina*).
Hard Fescue (*Festuca duriuscula*).
Orchard Grass (*Dactylis glomerata*).

This peculiarity in the growth of the last three grasses is prevented by close pasturing, rolling, and proper cultivation. These operations improve upon nature, since, if left to themselves, they would far more certainly assume the jungle growth, such as is often seen on poor, thin pasture soils; a close, fine, matted sward being attained only by careful cultivation.

The habit of jungle or tufted growth is, it will be perceived, rather an exceptional one, the general and one of the most important characteristics of the true grasses being to grow and form a turf on good soils. Many of the sedges and some of the coarse grasses form tussocks in wet meadows and swampy places, while neither wheat, rye, barley, nor oats, ever form a close turf or sward.

A little reflection will lead to the conclusion that it is mainly the better and more valuable grasses, such as Timothy, redtop, meadow foxtail, June grass, &c., which

have this property. This mode of growth has a far more important bearing upon practical agriculture than one, at first view, would suppose; since it stores away near the surface a vast accumulation of materials of great value in improving the qualities of the soil, when turned over, to say nothing of the beauty it adds to the landscape, or the firmness it gives to the surface of the earth.

II. The Aquatic or Water Grasses form another distinct group; and among these are the

Reed Canary Grass (*Phalaris arundinacea*).
Common Reed Grass (*Phragmites communis*).
Water Spear Grass (*Glyceria aquatica*).
Common Manna Grass (*Glyceria fluitans*).
Rice Grass (*Leersia oryzoides*).
Floating Foxtail (*Alopecurus geniculatus*).
Wild Rice (*Zizania aquatica*).

These grasses grow mostly in water, and are not cultivated with us as agricultural grasses, with the exception, perhaps, of the first. Wild rice grass is sometimes cultivated, and yields large crops at the South, and floating foxtail in Europe.

III. Marsh or Salt Grasses, among which we have
Salt Reed Grass (*Spartina polystachya*).
Rush Salt Grass (*Spartina juncea*).
Salt Marsh Grass (*Spartina stricta*).
Black Grass (*Juncus bulbosus*).
Beach Grass (*Ammophila arundinacea*).
Goose Grass (*Glyceria maritima*).

IV. Field or Pasture Grasses.—Under this head may be included a very large number of species, all of which have been described above. They might be subdivided according to the soils and situations which they naturally affect; for, though a grass may sometimes be

found or placed in a soil which is not naturally fitted for it, yet no species will arrive at its most perfect development on a soil not well adapted to it.

Among these might be mentioned, as examples,

Timothy (*Phleum pratense*).
Meadow Foxtail (*Alopecurus pratensis*).
Common Spear Grass (*Poa pratensis*).
Orchard Grass (*Dactylis glomerata*).
Perennial Rye Grass (*Lolium perenne*).
Italian Rye Grass (*Lolium italicum*).
Redtop (*Agrostis vulgaris*).
Whitetop (*Agrostis alba*).
Downy Oat Grass (*Avena pubescens*).
Meadow Soft Grass (*Holcus lanatus*).
Meadow Fescue (*Festuca pratensis*).
Field Barley Grass (*Hordeum pratense*).
Tall Oat Grass (*Arrhenatherum avenaceum*).

Timothy, as has already been seen, is the standard field grass in this group, and is suited to all climates of this country north of Virginia and Tennessee, though it sometimes suffers from drought in states further north. It is a field, and not a pasture grass, as it will not endure very close and frequent cropping. This is seen in the readiness with which a Timothy stubble parches up, unless there is rain or cloudy weather immediately after it is cut.

V. Annual Weeds, which, though proper grasses, are often very troublesome in cultivated grounds, either on account of their creeping, underground stems, or their rapid and luxuriant growth. Thrifty farming is a ceaseless struggle against these pests, and the farmer is generally careful to keep as clear as possible of them. Among these may be named

Chess (*Bromus secalinus*).
Soft Brome Grass (*Bromus mollis*).
Slender Foxtail (*Alopecurus agrestis*).
Fiorin (*Agrostis stolonifera*).
Couch Grass (*Triticum repens*).
Rough-stalked Meadow (*Poa trivialis*).
Annual Spear Grass (*Poa annua*).
Blue or Wire Grass (*Poa compressa*).

Of these, the last four are not always considered as weeds, since they are sometimes sown as pasture grasses; but, when they appear in cultivated grounds, in gravel-walks, and avenues, they are exceedingly troublesome, and difficult to eradicate.

VI. Grasses adapted for Culture as Green Manuring Plants.—It is evident, on reflection, that green vegetable manuring is the natural and cheapest means of replenishing the constant waste and exhaustion of the richer qualities of the soil in the production of grains and the higher grasses used in the nourishment of animals, especially when these products are consumed at a distance from where they grew. It is rare that the farmer restores to the soil all or as much as he takes from it. Even the animal can hardly be said to restore to the land on which he feeds all he takes from it, unless his body is left to decay beneath the surface of the sod which helped to build up his bony and muscular frame; and this is rarely the case in practical farming. The farmer himself sells more or less of the products of his labor and of his soil to be transported to considerable distances, never to be restored; and hence the land very rarely receives the full compensation for what has been taken from it in the shape of hay, grains, vegetables, or pasturage.

Nature, left to herself, prevents any exhaustion by the

boundless luxuriance of vegetable growth. Light and air, heat and water, are the sources of vitality, and they become incorporated, as it were, or assume a tangible form, in the green masses produced in the surface of the earth; and these, in decaying, constantly increase the fertility of the soil, because they not only restore to it the inorganic substances which they took from it, but many others which they drew from the atmosphere, and embodied in their leaves, and stalks, and roots.

The atmosphere is known to be full of the very elements which it is most desirable to secure and turn to our own use; and there is no way in which the farmer can avail himself of these invaluable aids so surely as by embodying them in the form of green vegetable masses, and turning them fresh beneath the surface, where they soon decay, and are ready to nourish other vegetable bodies, that is, to produce crops which are of money value.

Green manuring has rarely, or never, failed of producing satisfactory results, when it has been economically and judiciously applied; and its value as the true mode of fertilizing the earth has been sufficiently proved in practice, in cases where the farmer has ploughed in clover, buckwheat, oats, &c. The result or effect of green manuring is well known, and the truth of the system is sufficiently shown in the fact that it is strictly in accordance with nature.

But our ordinary modes have usually been too expensive, either on account of the cost of the seed of the clovers or other large seeds, or in causing the loss of the crop for the year, that is, in fallowing; or in failing to secure the full benefit of the system, from the use of too few varieties or species of plants, and consequently having too small a mass of vegetable matter; yet, notwithstanding this failure to secure the highest advan-

tages of which the system is susceptible, the farmer has, by means of turning in green crops, increased the amount and depth of the mould in his soil, and thus fitted it to produce a stronger stalk and more perfect grain, and saved the expense and labor of hauling the heavier manures, his green crops for manuring being ready at hand.

Now, instead of relying upon clover or buckwheat mainly, which has commonly been the case, suppose the farmer should select the seeds of such vegetables as are adapted to this system, and productive of the best results, and take pains to plant them for the express purpose of green manuring, either along with his wheat and other winter grain, to be turned in green with the stubble the following summer, or in the spring, to be ploughed in in autumn on wheat-land, or land to be sown with other winter crops.

His object would be to produce the largest possible mass. He should, then, select the smallest-seeded plants, other things being equal, and a large variety of them. These seeds may be selected by himself on his own farm, and cost him only the trouble of gathering, say from fifty cents to a dollar for ten pounds, or enough to sow an acre, while he may bring about far more satisfactory results in the infinitely greater mass of vegetable matter which he can thus produce.

This is an important consideration, not only from the fact that a great variety will hasten the fermentation in the soil, and thus materially elevate the temperature, but because different varieties or species of plants take from the atmosphere and embody different elements, and also because it is only by a large number of species that a close, thick mass can be obtained. The best results can only be brought about by the vigor of growth and the variety. The vigor of growth depends

much upon the great variety, and the variety is attained cheaply by plants of small seeds.

In a pound of buckwheat, for instance, there are only about fifteen thousand seeds; in red clover, a little over two hundred and fifty thousand; in rye and oats, about twenty thousand; while in many of the best plants for manuring, there are over a million grains to the pound.

In what does the superiority of clover as a green manuring plant consist? Is it not in the vast amount of water stored away in its succulent leaves and stems, which causes it to decay with great rapidity when buried in the soil, and thus furnish a supply of fertilizing materials in the quickest manner? In this respect it is no doubt exceedingly valuable for the purpose; but is it not possible to render other plants, whose seeds are far less expensive, equally watery and luxuriant, by sowing them thickly together, and by a judicious selection of large and leafy plants for protecting the smaller ones by their shade?

If the above suggestions are worthy of consideration, it would seem to follow that many of the plants now regarded as weeds, and never cultivated, except in some cases for the beauty of their flowers, may be valuable to sow and turn in as green manure. Any plants, indeed, which will grow with others, and form a great mass of green vegetable growth, embodying and corporifying the fertilizing elements of the air, may be made useful and serviceable to the farmer.

It is not my purpose, in this connection, to develop a complete system of green manuring by a description of all the plants most valuable to be used for this object, but only to suggest that some of the species of the grasses which have been alluded to in the preceding pages may be important as green manure plants, espe-

cially to sow with some of the larger and ranker plants, which may serve to protect them, and to leave the reader, who may be interested in experimenting in this direction, to add to the mixtures according to his judgment and pleasure, bearing in mind that when used for the green manuring, neither the coarser plants nor the grasses are allowed to blossom and go to seed, the design being to turn them in before this stage of their growth, in which case the ground is not injured by foul seeds. Suppose, then, we take, as

GREEN MANURING GRASSES,

One pound of	Bristly Foxtail,	600,000 seeds.
" " "	Wood Hair Grass,	2,000,000 "
" " "	Tufted Hair Grass,	2,000,000 "
" " "	Meadow Soft Grass,	1,500,000 "
" " "	Perennial Rye Grass,	250,000 "
" " "	Chess,	150,000 "
" " "	Millet Grass,	1,200,000 "
" " "	Melic Grass,	500,000 "
" " "	Tall Oat Grass,	350,000 "
" " "	Tickle Grass,	4,000,000 "

These are some of the wild grasses which will suggest themselves to the mind of the reader, who has made himself familiar with the natural history of the grasses, as given in chapter first, and such as are adapted for use on medium soils; and they may be increased, as already intimated. They are all to be found in the places indicated, their seeds collected and saved for sowing as a top-seed with grains. One pound of each is stated, for the purpose of indicating the number of seeds it contains. This number cannot, of course, be strictly accurate, because it will always vary a little, according to its cleanliness and freedom from chaff; but it is sufficiently so for practical purposes. Only about five million seeds are required for an acre, so that the number of pounds needed to seed

thickly and well can be easily calculated, taking the requisite quantities of each species, and the average number of seeds to the pound. The number of different species taken, including some of the larger-leaved or protection plants, should be at least as many as ten; the more the better, as they will more surely form a close, thick mass of green vegetation.

Of the better grasses suited to this top-seed manure culture on medium soils, might be mentioned the

Tall Fescue,	of	about	325,000	seeds	to	the	pound.
June Grass,	"	"	3,888,000	"	"	"	"
Meadow Fescue,	"	"	420,000	"	"	"	"
Orchard Grass,	"	"	640,000	"	"	"	"
Timothy,	"	"	1,100,000	"	"	"	"
Quaking Grass,	"	"	7,000,000	"	"	"	"
Bermuda Grass,	"	"	700,000	"	"	"	"
Striped Grass,	"	"	670,000	"	"	"	"

Making use of a mixture of some or all of the species named above, together with more or less plants of a larger and ranker growth, we might form a heavy mass to turn under and enrich and mellow the soil.

Such as would be suited to a heavy clay soil may be selected from the above, bearing in mind that the larger plants to be sown with them should be such as penetrate deeply, and grow with a rank and vigorous growth. In a similar manner may be selected mixtures for light sands, by a reference to grasses that affect such soils, as described in the first chapter.

To carry out a complete system of green manuring, requires some little time in securing the seeds; and this the farmer must attend to personally, if he wishes to have them fresh and good. There is scarcely any plant that grows along his fields, pastures, and roadsides, that may not be made serviceable as a green manure, if judiciously managed, and sown and turned under in the proper season. The economy of green manuring

depends upon being able to throw in the vegetable growth between the other and valuable crops, without the loss of time or land. To adopt it, the farmer will need to observe, and become familiar with, to some extent, the plants on his farm; and if he finds, by experiment, that green manuring is effective in giving him better crops at less expense, he will need to have a seed-bed for many of the plants he may wish to use, in order to be sure of a regular and constant supply of seed.

It will be easy to give the system of green manuring a fair and complete experiment, by taking a small piece, say a quarter or half an acre; and for this purpose the seeds of wild plants of the farm can be procured, grown, and turned in for wheat, rye, or oats, and the result noted.

VII. Litter Grasses. Many of the wild grasses grow with great luxuriance, and often in places very convenient to the barn or the homestead; and some of them, owing to their size and abundance of leaves, are admirably adapted for litter, and used as such they greatly increase the manure-heap.

A selection might be made of grasses of this description, which would produce as valuable a yield of litter as the straw of some of our grain crops. The following, with many others, might be suggested:

Common Reed Grass (*Phragmites communis*).
Lyme Grass (*Elymus virginicus*).
Canadian Lyme Grass (*Elymus canadensis*).
Slender Hairy Lyme (*Elymus striatus*).
Reed Canary Grass (*Phalaris arundinacea*).

All of these grasses have been described in chapter first, and their natural habitat given under each.

The various groups given above are suggested merely as examples, and innumerable others may be made to suit the reader's convenience, and as one of the means of becoming familiar with many species which are now everywhere and daily passed by unnoticed on the farm. Groups, for instance, might be formed of grasses best adapted for raising cattle, grasses best adapted for raising horses, those best adapted for grazing sheep, and those best adapted for milch cows and dairy farming.

CHAPTER VI.

THE COMPARATIVE NUTRITIVE VALUE OF THE GRASSES.

We have seen that the various species of grass differ very materially in nutritive value: that some contain the greatest quantity of nutritive matter when green or in the flower, others when the seed is ripe and the plant mature; that some yield a luxuriant aftermath, while others can scarcely be said to produce any at all; that some flourish in elevated situations, and are best suited to the grazing of sheep, while others grow most luxuriantly on the low lands and in the marshes, and sustain the richest dairies; and that no soil is so sterile, no plain so barren, but that a grass can be found adapted to it.

Some species, indeed, will not endure a soil even of medium fertility, nor the application of any stimulating manure, but cling, with astonishing tenacity, to the drifting sands, while others prefer the heaviest clays, or revel in the hot beds of ammonia; some are gregarious in their habits, requiring to be sown with other species, and, if sown alone, will linger along till the wild grasses spring up to their support; others are solitary, and, if mixed with different species, will either extirpate them, usurping to themselves the entire soil, or die and disappear. Nearly every species is distinguished for some peculiar quality, and most are deficient in some, comparatively few combining all the qualities

desired by us in alternate field crops, for pastures, or permanent mowing, to such an extent as to justify a general cultivation.

It is important, therefore, to learn the comparative nutritive value of each species thought to be worth cultivating; and it is the object of this chapter to throw some light upon this point.

This study is naturally attended with great difficulties. It is but recently that accurate researches have been made with a view of arriving at such positive results as would be entitled to full confidence.

In 1824, a very laudable attempt was made, in England, by the Duke of Bedford, at Woburn Abbey, to ascertain the comparative value of most of the grasses which could then be obtained; and the results of the experiments, conducted by his gardener, George Sinclair, were detailed in a volume under the title of "*Hortus Gramineus Woburnensis.*" This work, which was the first treatise worthy of mention on this subject, became the text-book on the grasses, and has been followed, by most subsequent writers, down to the present time. But these experiments must be regarded as very unsatisfactory, both on account of the imperfections of the methods of arriving at the results (though they were the best then known, and suggested by Sir Humphrey Davy), and because each species or variety was cultivated only to a very limited extent. The produce per acre, for instance, was calculated, in most cases, from the yield of four square feet. Besides this, very great discrepancies occur in the volume, which can with difficulty be accounted for.

The analyses recently made by Professor Way, the distinguished chemist of the Royal Agricultural Society, are more reliable, in my estimation, than any which can be found, and no treatise on the grasses would be com-

plete without giving the valuable results to which he has arrived.

It is now very well established that the nutritive value of the food of an animal depends greatly upon the proportion of nitrogenous substances contained in it. Without doubt, the sugar which is found to be an ingredient of most vegetable substances at some periods of their growth in some degree contributes to it also; so do the starch and other ingredients which combine to promote heat and respiration; for no doubt there is a mutual relation existing between the various elements of food, some going to sustain and nourish one part of the animal system, and others forming some other part, equally important to health and existence. Each may perform its function, and be not only important, but indispensable; but chemists have been accustomed to base the nutritive value of articles of food chiefly upon the nitrogenous compounds.

The nitrogenous constituents of any substance, as grass or hay, for instance, may be determined with little difficulty, and with great exactness, since it has been found, by abundant research, that, when present, they are of nearly the same constitution, and do not vary in their combinations. The determination of the sugar is somewhat more difficult.

The constituents of plants may accordingly be divided into two classes: one class embracing all those substances of which nitrogen or azote forms a part, and the other consisting of non-nitrogenous bodies. Gluten, albumen, gelatine, casein, legumen, and fibrin, belong to the former class, being nitrogenous substances; while starch, gum, sugar, woody fibre, mucilage, &c., are destitute of nitrogen, or non-nitrogenous.

Only a small quantity of nitrogen is found in vegetable substances, and it is derived in part, at least, from

the atmosphere, in the form of ammonia. On the other hand, nitrogenous substances form a large proportion of the constituents of the blood of animals, and appear in their whole system. As there is a constant waste in the animal, and a continual formation of new tissues, — as the whole body is constantly renewed through the agency of the blood which is converted into flesh and muscle, — there must be a never-failing supply of nourishment; and this nourishment for the higher animals is found, as already intimated, to a considerable extent, in the nitrogenous elements of plants.

For every ounce of nitrogen which the animal requires to sustain life, and build up the muscular and fleshy parts of his body, he must take into the stomach, in the shape of food, such a quantity of vegetable substances as will furnish him with an ounce of nitrogen in combination with other essential elements. If we suppose one kind of hay to contain one ounce of nitrogen to the pound, and another to have only half as much, or only an ounce in two pounds, the pound which contains the ounce of nitrogen would go as far to nourish the animal — other things being equal — as the two pounds which contain only the same quantity of nitrogen. The importance of woody fibre to act mechanically in giving bulk to the food is not, of course, to be overlooked.

Nor is this a mere deduction of theory. The experiment has frequently been made, and it is now fully established, both by science and experience, that the greater the proportion of nitrogen which any vegetable contains, if it also contains other important constituents in proper combination, the smaller will be the quantity of that vegetable required to nourish the animal body, and the less nitrogen any vegetable contains, the greater will be the quantity of it required.

Muscle and flesh are composed of nitrogenous princi-

ples, while fat is made up, to a great extent, of non-nitrogenous matter. Every keeper of stock knows that to feed an animal on oil-cake alone, for instance, which is but slightly nitrogenous, might fatten him, but it would not give him strength of muscle or size; while, if the same animal be kept on the cereal grains, as wheat or Indian corn, alone, his size rapidly increases, his muscular system develops, and he gains flesh without increasing his fat in proportion. These substances are usually given, therefore, as a part of the regular feed, only, or in connection with other and bulkier substances, as hay. It was with reference to these facts that Boussingault formed his tables of nutritive equivalents, and they agree very closely with the results of practical observation.

The non-nitrogenous substances are equally necessary for the production of fat, and to supply the animal body with heat; and thus they meet a want in the animal economy, although they do not, according to chemical investigations, contribute so directly to nourish and sustain the system. They are, therefore, important in the analyses of articles of food, though not so essential in determining merely their nutritive values.

From what has been said, the reader will very readily understand the following tables, containing the results of the investigations of Professor Way. The specimens of the various grasses, on which his researches were made, were analyzed both in their green state as taken from the field, and after being dried at a temperature of 212° Fahr., a point at which the moisture is found to be entirely expelled, and evaporation ceases, and the importance of both determinations must be obvious on a moment's reflection.

The names of the natural grasses, and the dates of their collection, are arranged in the following table:

Table IV.—Natural Grasses. Name and Date of Collection.

Common Name.	Botanic Name.	Date of Collection.	Character of the Soil.
Sweet-scented Vernal, .	Anthoxanthum odoratum, .	May 25,	Calcareous loam.
Meadow Foxtail Grass, .	Alopecurus pratensis, . . .	June 1,	Calcareous loam, gravelly subsoil.
Tall Oat Grass, ...	Arrhenatherum avenaceum,	July 17,	Forest marble loam.
Yellow Oat Grass, . . .	Avena flavescens, ...	June 29,	Forest marble loam.
Downy Oat Grass, . . .	Trisetum pubescens, ...	July 11,	Dry calcareous loam.
Quaking Grass, ...	Briza media, ...	June 29,	Forest marble.
Upright Brome, ...	Bromus erectus, ...	June 23,	Calcareous loam.
Soft Brome Grass, . . .	Bromus mollis, ...	May 8,	Stiff loam.
Crested Dog's-tail, . . .	Cynosurus cristatus, ...	June 21,	Calcareous loam.
Orchard Grass, ...	Dactylis glomerata, ...	June 13,	Calcareous loam on gravel.
Orchard Grass, ripe, . .	Dactylis glomerata, ...	July 19,	Calcareous loam.
Hard Fescue Grass, . .	Festuca duriuscula, ...	June 13,	Dry calcareous loam.
Meadow Soft Grass, . .	Holcus lanatus, ...	June 29,	Calcareous loam.
Barley Grass, ...	Hordeum pratense, ...	July 11,	Calcareous loam on gravel.
Perennial Rye Grass, . .	Lolium perenne, ...	June 8,	Calcareous rubbly loam.
Italian Rye Grass, . . .	Lolium Italicum, ...	June 13,	Forest marble loam.
Timothy, ...	Phleum pratense, ...	June 13,	Forest marble loam.
Annual Spear Grass, . .	Poa annua, ...	May 28,	Loam, with gravelly subsoil.
June Grass, ...	Poa pratensis, ...	June 11,	Dry calcareous loam.
Rough-stalked Meadow,	Poa trivialis, ...	June 18,	Calcareous loam.
Irrigated Meadow Grass,	First crop, ...	April 30,	Calcareous loam.
Irrigated Meadow Grass,	Second crop, ...	June 26,	Calcareous loam.
Annual Rye Grass, . .	– – –	June 8,	Calcareous rubbly loam.

In the same manner the name and date of collection of each specimen of artificial grass, analyzed, are arranged in Table V.

The inquiries of Professor Way were directed to ascertain

1. The proportion of water in each grass as taken from the field.

2. The proportion of albuminous or flesh-forming substances, including, without distinction, all the nitrogenous principles.

3. The proportion of oily or fatty matters, which may be called *fat-forming principles.*

4. The proportion of elements of respiration, or heat-producing principles, among which are included starch, gum, sugar, pectic acid, &c.; all the non-nitrogenous substances, indeed, except fatty matters and woody fibre.

5. The proportion of woody fibre.

6. The amount of mineral matter or ash.

TABLE V. — ARTIFICIAL GRASSES. NAME, AND DATE OF COLLECTION.

Common Name.	Botanic Name.	Date of Collection.	Character of Soil.
Red Clover, ...	Trifolium pratense, ...	June 7,	Tenacious loam.
Perennial Clover, . . .	Trifolium perenne, ...	June 4,	Calcareous loam.
Crimson Clover, ...	Trifolium incarnatum, . .	June 4,	Calcareous loam.
Cow Grass, ...	Trifolium medium, ...	June 7,	Tenacious loam.
Cow Grass. 2d lot, . . .	Trifolium medium, ...	June 21,	Calcareous loam.
Hop Trefoil, ...	Trifolium procumbens, . .	June 13,	Calcareous loam.
White Clover, ...	Trifolium repens, ...	June 18,	Forest loam.
Common Vetch, ...	Vicia sativa, ...	June 13,	Forest loam.
Sainfoin, ...	Onobrychis sativa, ...	June 8,	Dry loam.
Lucerne, or Alfalfa, . .	Medicago sativa, ...	June 16,	- -
Black Medick, or Nonsuch,	Medicago lupulina, ...	June 6,	Calcareous loam.

The specimens were picked out, plant by plant, each specimen by itself, from fields in which they were growing naturally, or mixed in the ordinary mode of cultivation, and were not raised expressly for analysis.

These tables of analyses, containing, as they do, the results of profound investigation, and forming, as they do, one of the most important contributions recently made to the science of agriculture, are worthy of careful study, and will be found to be full of the most valuable practical suggestions.

The results of the analysis of the natural grasses in the green state, as taken from the field, are arranged in Table VI., as follows:

TABLE VI. — ANALYSIS OF NATURAL GRASSES. (100 *parts as taken green from the field.*)

Name of Grass.	Water.	Albuminous or flesh-forming principles.	Fatty matters.	Heat-producing principles, — starch, gum, sugar, etc.	Woody fibre.	Mineral matter, or ash.
Sweet-scented Vernal, . .	80.35	2.05	.67	8.54	7.15	1.24
Meadow Foxtail, ...	80.20	2.44	.52	8.59	6.70	1.55
Tall Oat Grass, ...	72.65	3.54	.87	11.21	9.37	2.36
Yellow Oat Grass, ...	60.40	2.96	1.04	18.66	14.22	2.72
Downy Oat Grass, ...	61.50	3.07	.92	19.16	13.34	2.01
Quaking Grass, ...	51.85	2.93	1.45	22.60	17.00	4.17
Upright Brome Grass, . .	59.57	3.78	1.35	33.19		2.11
Soft Brome Grass, ...	76.62	4.05	.47	9.04	8.46	1.36
Crested Dog's-tail, ...	62.73	4.13	1.32	19.64	9.80	2.38
Orchard Grass, ...	70.00	4.06	.94	13.30	10.11	1.59
Orchard Grass, seeds ripe,	52.57	10.93	.74	12.61	20.54	2.61
Hard Fescue Grass, . . .	69.33	3.70	1.02	12.46	11.83	1.66
Meadow Soft Grass, . . .	69.70	3.49	1.02	11.92	11.94	1.93
Barley Grass, ...	58.85	4.59	.94	20.05	13.03	2.54
Perennial Rye Grass, . . .	71.43	3.37	.91	12.08	10.06	2.15
Italian Rye Grass, ...	75.61	2.45	.80	14.11	4.82	2.21
Timothy Grass, ...	57.21	4.86	1.50	22.85	11.32	2.26
Annual Spear Grass, . . .	79.14	2.47	.71	10.79	6.30	.59
June Grass, ...	67.14	3.41	.86	14.15	12.49	1.95
Rough-stalked Meadow, .	73.60	2.58	.97	10.54	10.11	2.20
Irrigated Meadow Grass, .	87.58	3.22	.81	3.98	3.13	1.28
Irrigated Meadow, 2d crop,	74.53	2.78	.52	11.17	8.76	2.24
Annual Rye Grass, . . .	69.00	2.96	.69	12.89	12.47	1.99

A glance at the first column of Table VI. will show a striking difference in the percentage of water, it being as high as 80 in some instances, while it falls as low as 60, and in one instance to 51, without considering the second specimen of orchard grass, — in which the seed was allowed to ripen, when, of course, the amount of water would be much less than at the period of flowering, — or the irrigated grasses.

It will be noticed that those grasses which come earliest into flower are generally the most succulent, though this is not uniformly the case.

It will be seen, also, that the sweet-scented vernal grass and the meadow foxtail contain but 20 parts in 100 of dry, solid matter, while the yellow oat and the downy oat grasses contain nearly double, or about 40 per cent. This difference, though of no great importance in itself, is cf some interest in showing that, to judge of the quantity of hay a given burden of grass will produce, it is necessary to consider the species of grass which mainly composes the meadow, since it is evident that a given weight of one variety might make double the quantity of the same weight of another.

But the chief interest of the table is to be found in columns three, four, and five. The albuminous or flesh-forming principles will be found to be double in some instances what they are in others; and, in accordance with the principles laid down in the explanatory remarks which precede the tables, some would appear to be more than twice as nutritive as others; but it should be borne in mind that these differences depend in part on the variations in the quantity of water, and that the real differences will appear more apparent in the dried specimens.

A glance at Table VII. will show that the percentage of water in the artificial grasses, as taken from the field, is greater than that of the natural grasses under the same circumstances. The percentage of albuminous or flesh-forming principles is generally, though by no means uniformly, less than that of our best grasses. Compare red clover, for instance, with Timothy, and the first striking peculiarity is the difference in the amount of water; in the one case exceeding 81 per cent., leaving but 19 per cent. of solid matter, from

which the flesh-forming and other nutritive substances must be drawn; while in Timothy the water amounts to only a little over 57 per cent., leaving 43 per cent. of solid substances containing nutritive principles.

This is an important difference, to begin with. The percentage of flesh-forming principles of the two plants does not, at first sight, appear to differ very materially, the clover containing 4.27, the Timothy 4.86; but a little consideration of the exceeding value of this constituent will show that the latter has an important advantage in this respect over the clover. In fat-forming principles the Timothy is more than twice as rich as clover; while in heat-producing principles — also very valuable — Timothy far surpasses clover, the one producing 22.85 per cent., and the other only 8.45 per cent. Of waste and useless matter in the shape of woody fibre Timothy contains the largest per cent., while the larger quantity of mineral matter shows it also to be a greater exhauster of the soil. The most valuable practical de-

TABLE VII. — ANALYSIS OF ARTIFICIAL GRASSES.
(100 *parts, as taken from the field.*)

Name of Plant.	Water.	Albuminous or flesh-forming principles.	Fatty matters.	Heat-producing principles, — starch, gum, sugar, etc.	Woody fibre.	Mineral matter, or ash.
Red Clover, ...	81.01	4.27	.69	8.45	3.76	1.82
Perennial Clover, ...	81.05	3.64	.78	8.04	4.91	1.58
Crimson Clover, ...	82.14	2.96	.67	6.70	5.78	1.75
Cow Grass, ...	74.10	6.30	.92	9.42	6.25	3.01
Cow Grass, 2d specimen, .	77.57	4.22	1.07	11.14	4.23	1.77
Hop Trefoil, ...	83.48	3.39	.77	7.25	3.74	1.37
White Clover, ...	79.71	3.80	.89	8.14	5.38	2.08
Common Vetch, ...	82.90	4.04	.52	6.75	4.68	1.11
Sainfoin, ...	76.64	4.32	.70	10.73	5.77	1.84
Lucerne, or Alfalfa, . . .	69.95	3.83	.82	13.62	8.74	3.04
Black Medick, or Nonsuch,	76.80	5.70	.94	7.73	6.32	2.51

ductions of a similar nature may be made by comparing these tables.

TABLE VIII.—ANALYSIS OF NATURAL GRASSES. (100 *parts of the grass dried at* 212° *Fahr.*)

Name of Grass.	Albuminous or flesh-forming principles.	Fatty matters.	Heat-producing principles,—starch, sugar, gum, &c.	Woody fibre.	Mineral matter, or ash.
Sweet-scented Vernal Grass, .	10.43	3.41	43.48	36.36	6.32
Meadow Foxtail, ...	12.32	2.92	43.12	33.83	7.81
Tall Oat Grass, ...	12.95	3.19	38.03	34.24	11.59
Yellow Oat Grass, ...	7.48	2.61	47.08	35.95	6.88
Downy Oat Grass, ...	7.97	2.39	49.78	34.64	5.22
Quaking Grass, ...	6.08	3.01	46.95	35.30	8.66
Upright Brome Grass, ...	9.44	3.33	82.02		5.21
Soft Brome Grass, ...	17.29	2.11	38.66	36.12	5.82
Crested Dog's-tail, ...	11.08	3.54	52.64	26.36	6.38
Orchard Grass, ...	13.53	3.14	44.32	33.70	5.31
Orchard Grass, seeds ripe, . .	23.08	1.56	26.53	43.32	5.51
Hard Fescue Grass, ...	12.10	3.34	40.43	38.71	5.42
Meadow Soft Grass, ...	11.52	3.56	39.25	39.30	6.37
Meadow Barley Grass, . . .	11.17	2.30	46.68	31.67	6.18
Perennial Rye Grass, ...	11.85	3.17	42.24	35 20	7.54
Italian Rye Grass, ...	10.10	3.27	57.82	19.76	9.05
Timothy, ...	11.36	3.55	53.35	26.46	5.28
Annual Spear Grass, ...	11.83	3.42	51.70	30.22	2.83
June Grass, ...	10.35	2.63	43.06	38.02	5.94
Rough-stalked Meadow, . . .	9.80	3.67	40.17	38.03	8.33
Irrigated Meadow Grass, . . .	25.91	6.53	32.05	25.14	10.37
Irrigated Meadow (2d crop), .	10.92	2.06	43.90	34.30	8.82

In the case of orchard grass and the irrigated meadow, in Table VIII., the seeds were ripened, and they should not, therefore, be compared with other grasses taken in the blossom, without considering this fact. It will be seen, too, that the specimens analyzed were in the dry state, much drier than they could be made by the ordinary process of hay-making; for, however perfectly the hay is cured, it will still contain a very considerable per-

centage of water, and, if artificially dried, as in the trials given above, and then exposed to the air, it will absorb from 10 to 15 per cent. of water, showing that no hay is absolutely dry by any ordinary processes. In England, the percentage of water in well-made hay is about 16, and hay artificially dried will absorb that amount, if exposed again to the air. I do not think the percentage here would be so large, for obvious reasons. In the analysis of the hay of the reed canary grass, made by Professor Horsford, and given on a preceding page, the percentage was but 10.24. That was a well-cured specimen, taken after it had passed the period of blossoming, and the amount of water is, perhaps, slightly below the average.

It will be seen that a great difference exists in the valuable constituents of the grasses.

	Lowest.	Highest.	Average.
Flesh-forming principles, ...	6.08	17.29	11.68
Fat-producing principles, ...	2.11	3.67	2.89
Heat-giving principles, ...	38.03	57.82	47.92

TABLE IX.—ANALYSIS OF ARTIFICIAL GRASSES. (*In 100 parts of the grass dried at* 212° *Fahr.*)

Name of Plant.	Albuminous or flesh-forming principles.	Fatty matters.	Heat-producing principles,—starch, sugar, gum, etc.	Woody fibre.	Mineral matter, or ash.
Red Clover, ...	22.55	3.67	44.47	19.75	9.56
Perennial Clover, ...	19.18	4.09	42.42	25.96	8.35
Crimson Clover, ...	16.60	3.73	37.50	32.39	9.78
Cow Grass, ...	24.33	3.57	36.36	24.14	11.60
Cow Grass, 2d specimen, . . .	18.77	4.77	49.65	18.84	7.97
Hop Trefoil, ...	20.48	4.67	43.86	22.66	8.33
White Clover, ...	18.76	4.38	40.04	26.53	10.29
Common Vetch, ...	23.61	3.06	39.45	27.38	6.50
Sainfoin, ...	18.45	3.01	45.96	24.71	7.87
Lucerne, or Alfalfa, ...	12.76	2.76	40.16	34.21	10.11
Black Medick, ...	24.60	4.06	33.31	27.19	10.84

A glance at this table will show that the different principles in the artificial grasses vary, to a great extent, as follows:

	Lowest.	Highest.	Average.
Flesh-forming principles, ...	12.76	24.60	18.68
Fat-producing principles, ...	2.76	4.77	3.76
Heat-giving principles, ...	33.31	49.65	41.48

The difference in composition exhibited in the natural grasses of Table VIII. is very marked, and of course the value of the grasses as compared with each other must vary greatly. Still, the practical value of a grass depends somewhat upon circumstances which cannot be analyzed, such as the period at which it arrives at maturity, and the particular soil and location of the farmer. It might happen that a grass, not in itself so rich in nutritive qualities as another, would be preferred, on account of its coming to maturity just at the time when the farmer most needed it. But this table shows the comparative nutritive qualities of the grasses, since all the specimens were collected and investigated in the same manner, at the same period of growth, — or as nearly as possible, — when in the flower, so that, whatever sources of error might exist to modify the results, they would naturally apply to all alike.

The grasses from the irrigated meadow consisted principally of June, or Kentucky blue grass, rough-stalked meadow grass, perennial rye grass, meadow soft grass, barley grass, meadow oat grass, and a few other species; and it will be noticed that in combination they abound in flesh and fat forming principles to a greater extent than we should be led to suppose from the composition of any one of them alone.

Our cultivated Timothy compares very favorably with the other grasses, containing a less percentage of useless matter, as woody fibre, than any other, except Ital-

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ian rye grass and crested dog's-tail, a grass not common with us, and the irrigated grasses. In point of soluble, heat-producing principles, sugar, gum, and starch, it is surpassed by the Italian rye grass, but by no others. The analyses of this grass in its green and dry states in Tables VI. and VIII. fully justify the preference which we have long shown for the use of Timothy; for, as taken from the field at the time of blossoming, it will be found to contain less water, a greater percentage of flesh and fat forming principles, and less useless matter in the shape of woody fibre, than most of the other grasses. The deductions of science certainly correspond, in this case, with the results of practice.

A comparison of Tables VI. and VIII. with Tables VII. and IX. will show the comparative advantages of the use of the artificial grasses, in point of albuminous or flesh-forming principles, and fatty matters. The carbonaceous or heat-producing principles remain nearly the same throughout, while the percentage of waste matter or woody fibre is less than in the natural grasses. This is an important fact, worthy of the careful consideration of the farmer.

In the sixth column of Table VIII. will be found the percentage of ash of each of the grasses analyzed. Table X. contains a still further analysis of this ash, which gives all the inorganic constituents which the plant derives from the soil and the manures furnished to it. It is important and suggestive to one who will examine it carefully, as indicating the kind of manure which in many cases it may be desirable to apply, while it will throw still further light upon the practical and comparative values of each species which the farmer proposes to cultivate, by showing the extent to which it will be likely to exhaust the soil.

TABLE X. — ANALYSIS OF THE ASH OF SOME OF THE NATURAL AND ARTIFICAL GRASSES.

Common Name.	Ash in 100 parts of dried grass.	Silica.	Phosphoric acid.	Sulph. acid.	Carb. acid.	Lime.	Magnesia.	Peroxide of iron.	Potash.	Soda.	Chloride of potassium.	Chloride of sodium.
Meadow Foxtail, ...	7.81	38.75	6 25	2.16	.65	3.90	1.28	.47	37.03	–	9.50	–
Sweet-scented Vernal, . .	6.32	28.36	10.09	3.39	1.26	9.21	2.53	1.18	32.03	–	7.03	4.90
Downy Oat Grass, . . .	5.22	36.28	10.82	3.37	–	4.72	3.17	.72	31.21	–	4 05	5.66
Upright Brome Grass, .	5.21	38.48	7.53	5.46	.55	10.38	4.99	.26	20.33	–	10.63	1.38
Soft Brome Grass, . . .	5.82	33.34	9.62	4.91	9.07	6.64	2.60	.28	30.09	.33	–	3.11
Crested Dog's-tail, . . .	6.38	40.11	7.24	3.20	–	10.16	2.43	.18	24.99	–	11 60	–
Orchard Grass, ...	5.31	26.65	8.60	3.52	2.09	5.82	2.22	.59	29 52	–	17.86	3.09
Orchard Grass, with seeds ripe, ...	5.51	32.18	6.41	3.96	2.88	8.14	3.47	.23	33.06	–	4.87	4.76
Hard Fescue Grass, . .	5.42	28.53	12.07	3.45	1.38	10.31	2.83	.78	31.84	–	8 17	.62
Meadow Soft Grass, . . .	6.37	28.31	8.02	4.41	1.82	8.31	3.41	.31	34.83	–	3.91	6.66
Meadow Barley Grass, .	5.67	56.23	6.04	4 29	–	5 04	2 42	.66	20.26	3.40	–	1.66
Perennial Rye Grass, . .	7.54	27.13	8.73	5 20	.49	9.64	2.85	.21	24 67	–	13.80	7.25
Annual Spear Grass, . .	2.83	16.03	9.11	10.18	3.29	11.69	2.44	1 57	41.86	–	.47	3.35
June Grass, ...	5.94	32.93	10.02	4.26	.40	5.63	2.71	.28	31.17	–	11 25	1 31
Rough-stalked Meadow Grass, ...	8.33	37 50	9.13	4.47	.29	8.80	3.22	.29	29.40	–	6.90	–
Timothy, ...	5.29	31.09	11.29	4.86	4.02	14.94	5.30	.27	24 25	–	.70	3.24
Annual Rye Grass, . . .	6.45	41.79	10.07	3.45	–	6.82	2.59	.28	28 99	.87	–	5.11
Yellow Oat Grass, . . .	5.28	35.20	9.31	4 00	–	7.98	3.07	2 40	36.06	.73	–	1.25
Red Clover, ...	9.56	.59	6.71	1.85	23.47	22.62	4.08	.26	36.45	–	2.39	1.53
White Clover, ...	–	3.68	11 53	7.21	18.03	26.41	8.15	1 96	14.33	3.72	–	4 95
Sainfoin in flower, . . .	6.37	3.22	9.35	3.28	15.20	24.30	5.03	61	31.90	–	6.24	.78
Sainfoin in seed, ...	6.50	3.49	7.97	2.33	17.36	29 67	4.59	.58	29.61	1.25	–	3.12
Italian Rye Grass in flower,	6.97	59.18	6 34	2.82	-	9.95	2.23	.78	12.45	3.98	–	2.27
Italian Rye Grass in seed,	6.40	60.62	6.32	1.31	–	12.29	2.64	.30	10.77	.13	–	5.58

A careful examination of the analyses of the ash, or the inorganic constituents of the grasses, will reveal the fact that some important substances are taken from the soil in large quantities, and if the grass is removed in the form of hay, that these must in some way be restored in manure, or exhaustion will follow. Among these are large percentages of silica, which is taken up in solution with water. Phosphoric acid is removed in large quantities, generally found in combination with

lime, magnesia or iron. The amount of potash is also very large, and it is found in combination with silicic acid.

Take the most careful analyses of the grasses as the basis of calculation, and it will appear that the weight of silicates, phosphates, and potash, removed from the soil in every ton of hay, is not less than one hundred and fifty pounds. Supposing, then, that the crop of hay averages two tons to the acre, — and it will rarely fall below this on good soils and under fair cultivation, — and it appears that about three hundred pounds of these valuable substances are abstracted from the soil of every acre so cropped, and this course of culture could not long continue without the return of these constituents to the soil. And hence the manures required for these lands are such as contain these substances, such as ashes, lime, and other applications rich in silicates, phosphates, and potash.

Lime is found in much less quantities than potash in most of the grasses, but the relative proportions differ in different species. In orchard grass, for instance, the lime amounts to only 5.82 per cent., while the amount of potash is 29.52. But in Timothy the lime amounts to nearly 15 per cent., and the potash to over 24. Soda is found in considerable quantities in some species, and is wanting in most.

No one of the grasses appears to be better adapted to supply the wants of animals than Timothy. Its amount of phosphates is larger than that of any other.

The amount of water in the stem is greater than in the leaf, so that the percentage of nutriment is greater in the leaf and flower stalk or panicle than in the stem. It has been found, by actual and often repeated experiments, that grass loses more than half of its weight of water in curing; and it never becomes so dry, by any

of the ordinary modes of curing, as to lose all its water. It has already been remarked that the average percentage of water found in well-cured hay, in England, is about sixteen, and in this country from ten to fourteen per cent. of water will always be found in sun-dried hay.

The water or aquatic grasses, and the swamp sedges, contain a much larger percentage of water than the upland grasses, while their amount of ash, or inorganic constituents, is proportionally small. They are not, therefore, valuable for fodder, though, as I have said, they are often eaten, especially in spring, or when they are succulent and tender.

The following analysis, by Salisbury, of the soft rush (*Juncus effusus*), will serve as an example of the composition of many of this class of plants. The stalk, cut in a swamp on the 22d of June, weighed 46 grains. It contained

46.586	per cent. of water ;
53.414	" " " dry matter ;
0.978	" " " ash ;
1.831	" " " ash calculated dry ;

while the organic matter calculated dry amounted to 98.169. The proportion of inorganic matter, it will be seen, was very small.

The slender club-rush (*Eleocharis tenuis*) shows a somewhat similar composition. It was cut in blossom, and had of

Water,	38.241.
Dry matter,	61.759.
Ash,	2.663.

The ash calculated dry was found to be 4.312 per cent., and the organic matter calculated dry to be 95.688 per cent.

A comparison of the analyses of the ash of the natural and artificial grasses will reveal the fact that the

latter contain a very much larger amount of lime and potash than the former, and for this reason they have very properly been denominated lime-plants. It will be seen also, from their composition, that phosphoric acid forms an important ingredient in them, while the silica is very small, comparatively. The removal of a clover crop, therefore, without applying suitable manures, will exhaust the soil quite as much as a crop of the cultivated grasses, though of different constituents. A soil, to bear good clover crops, requires a considerable ingredient of lime, potash, and phosphates, and without the application of these manures in some form or other they will inevitably run out. Plaster of Paris, lime, and ashes leached and unleached, applied to clover soils, are always followed with good effects.

TABLE XI. — ANALYSIS OF SPECIMENS OF WEEDS, AS TAKEN FROM THE FIELD, AND WHEN DRIED.

Name of Plant.	Date of collection.	Water.	Albuminous matter.	Fatty matter.	Heat-producing principles.	Wood fibre.	Ash.
Ox-eye Daisy (*Crysanthemum leucanthemum*), ...	June 23,	71.85	2.12	.999	12.64	10.51	1.86
Yellow Buttercup (*Ranunculus acris*),	June 13,	88.15	1.18	.507	6.26	3.00	.91
Sorrel (*Rumex acetosa*), ...	July 4,	75.37	1.90	.545	7.62	13.04	1.51
DRIED SPECIMENS OF THE SAME.							
Ox-eye Daisy, ...	. . .	. .	7.53	3.49	45 02	37.33	6.63
Buttercup, ...	. . .	. .	9.98	4.28	52 69	25.34	7.71
Sorrel, ...	. . .	. .	7.71	2.19	46.82	37 16	6.12

If now we cast our eye at the analyses of some of our common weeds, we shall see how far superior the cultivated grasses are in nitrogenous or nutritive principles.

The albuminous principles are very much less than in either the natural or the artificial grasses.

A line of investigation, both scientific and practical, equally interesting and valuable with the foregoing, would lead into the comparative nutritive equivalents of hay and other feeding substances. This is not the place to discuss that subject in full, the line of our present inquiry embracing only the comparative nutritive values of the grasses themselves. For convenience of reference, however, I subjoin the following Table (XII.), embracing the results of the profoundest researches of many distinguished chemists and practical men, both in the laboratory and the barn. Boussingault and others, in France, and Fresenius, Thaer, and others, in Germany, have devoted to these and similar investigations the best part of their lives.

It is necessary to remark that tables of nutritive equivalents are liable to imperfections, on account of sources of error which must exist in the nature of things, as difference of soil, climate, season, imperfection of methods of analyses, &c.; but, making all allowance for these, and admitting that the table cannot be absolutely and literally correct or perfect, it possesses great practical value and interest, as giving a good general idea of the relative value for feeding purposes of various agricultural products.

In regard to the nutritive value, as based on the amount of nitrogen or nitrogenous compounds, it may be remarked that the latest and most careful experiments, conducted by most experienced and competent experimenters, tend to show that this basis is correct, so far as it can be applied to substances so analogous in composition that they can be included in one group; as, for example, the different root crops possess a nutritive value in proportion to the amount of nitrogen they contain, but the nutritive value of a root ought not to be compared with a succulent plant, like clover,

TABLE XII.—NUTRITIVE EQUIVALENTS. (PRACTICAL AND THEORETICAL.)

ARTICLES OF FOOD.	THEORETICAL VALUES. Boussingault.				Fresenius.		Practical values, as obtained by experiments in feeding, according to						
	Water in 100 parts.	Nitrogen in 100 parts of dried substance.	Nitrogen in 100 parts of undried substance.	Nutritive equivalent.	Relative proportion of nitrogenized to non-nitrogenized substances.	Nutritive equivalent.	Block.	Petri.	Meyer.	Thaër.	Pabst.	Schwertz.	Schweitzer.
English Hay,	11.0	1.34	1.15	100	–	100	100	100	100	100	100	100	100
Lucerne,	16.6	1.66	1.38	83	–	–	–	90	–	90	100	100	–
Red Clover-hay,	10.1	1.70	1.54	75	1 to 6.08	77.9	100	90	–	90	100	100	–
Red Clover (green),	76.0	–	.64	311	–	–	430	–	–	450	425	–	–
Rye-straw,	18.7	.30	.24	479	1 to 24.40	527 7-12	200	500	150	666	350	–	267
Oat-straw,	21.0	.36	.30	383	1 to 12.50	445 5-12	200	200	150	190	200	400	200
Carrot-leaves (tops),	70.9	2.94	.85	135	–	–	–	–	–	–	–	–	–
Swedish Turnips,	91.0	1.83	.17	676	–		–	300	–	300	250	200	–
Mangold Wurzel,	–	–	–	–	1 to 7.26	391⅓	366	400	250	460	250	333	366⅔
White Silician Beet,	85.6	1.43	.18	669	–	–	–	–	–	–	–	–	–
Carrots,	87.6	2.40	.30	382	1 to 7.84	542.1	366	250	225	300	250	270	300
Potatoes,	75.9	1.50	.36	319	1 to 9.00	330 5-12	216	200	150	200	200	200	200
Potatoes kept in pits,	76.8	1.18	.30	383	–	–	400	.	–	–	–	–	–
Beans,	7.9	5.50	5.11	23	1 to 2.8	34 5-12	30	54	50	73	40	–	30
Peas,	8.6	4.20	3.84	27	1 to 2.14	34½	30	54	48	66	40	Boussingault.	30
Indian Corn,	18.0	2.00	1.64	70	1 to 6.55	–	–	52	–	–	–	59	–
Buckwheat,	12.5	2.40	2.10	55	1 to 6.05	93 5-12	–	64	–	–	–	–	–
Barley,	13.2	2.02	1.76	65	1 to 4.25	–	33	61	53	76	50	–	35
Oats,	12.4	2.22	1.92	60	1 to 4.08	58 11-12	39⅓	71	–	86	60	–	37½
Rye,	11.5	2.27	2.00	58	1 to 4.42	58 1-16	33	55	51	71	50	–	33⅓
Wheat,	10.5	2.33	2.09	55	1 to 2.42	38 5-6	27	52	46	64	40	–	30
Oil-cake (Linseed),	13.4	6.00	5.20	22	–	–	42	108	–	–	–	–	43

for instance, by the proportion of nitrogen in each, merely, without taking into consideration other properties. In other words, roots may be compared with each other on that basis merely, and grasses with each other, and leguminous plants with each other, but not root crops and grasses. This fact is alluded to as a possible source of error in some of the earlier researches of Boussingault, and not as materially affecting the practical value of the table.

The mode of using Table XII. is very simple. Good upland meadow hay — or what would be called in New England good English hay — is taken as a standard of comparison. Now, if we wished to produce the same results with carrots as with one hundred pounds of good, average English hay, we must use, according to Boussingault's column of equivalents, 382 pounds of carrots, or for each pound of hay 3.82 pounds of carrots; and, according to the practical experiments mentioned, 366 pounds, 250 pounds, 225 pounds, 300 pounds, and so on, to each 100 pounds of hay.

According to the theoretical values of Boussingault, 100 pounds of hay are equal in feeding qualities to 65 pounds of barley, 60 pounds of oats, 58 pounds of rye, or 55 pounds of wheat. While, according to the experiments of Thaer, 100 pounds of hay produced the same effect as 76 pounds of barley, 86 pounds of oats, 71 pounds of rye, 64 pounds of wheat.

With regard to the analyses of Tables VI., VII., VIII., and IX., some slight allowance should perhaps be made for difference of climate, since it is well known that grasses, as well as other plants, grown rapidly in a hot sun, which we usually have in the months of May, June, and July, contain a much larger amount of nutritive and saccharine matter than those grown slower, and in a greater amount of available moisture both in the atmos-

phere and the soil, which is ordinarily present in the climate of England. Every observing farmer knows that grasses grown on our low, reclaimed swamp lands, for instance, make less milk, and less flesh and fat in animals, than the same species grown on our dry, upland soils. The same difference must exist, to some extent, between our grasses and the grasses grown in a comparatively moist climate, where they have the advantage of more frequent rains, which push them to a more complete development and give them greater luxuriance, increasing, of course, the quantity of their produce, while their quality cannot be improved in the points alluded to.

CHAPTER VII.

THE CLIMATE AND SEASONS, AND THEIR INFLUENCE ON THE GRASSES.

We now come to consider the influence of climate upon the quantity and nutritive quality of the grasses.

No crop is more dependent on the seasons than the grasses. Every farmer knows that a moist spring, with rains evenly distributed over the months of April, May, and June, will insure him the most luxuriant crops of grass and hay; and he knows, also, that a dry, cold spring is fatal to their rapid and healthy development, and that he must, in such a spring, expect a comparatively small crop. These and many similar facts are familiar to every one.

It has also been found by observation that the grasses will vegetate when the temperature of the air is above the freezing point of water (32° Fahrenheit), provided the temperature of the soil ranges from 35° to 40°, while a lower temperature checks their growth. Vegetation, at temperatures higher than these, depends much on the amount of moisture and heat, both of the soil and the atmosphere.

Grass will not vegetate when the temperature of the air is higher than 66°, unless the soil is very moist. When the vapor of the air is at its maximum, or when the air is saturated with moisture, vegetation advances with the greatest rapidity; and this most frequently happens with us in the earlier growing months, April, May, and June. But when the moisture in the atmos-

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phere is slight, and the soil becomes dry, and the subsoil is porous, the turf of our fields and pastures suffers from drought, and scarcely a year passes over us when this does not happen.

A writer in the Journal of the Royal Agricultural Society, after many careful observations, comes to the conclusion, First, That the growth of grass is always proportionate to the heat of the air, if a sufficiency of moisture be present in the atmosphere. Second, That in the climate of England the moisture present is rarely sufficient to allow the temperature to have full effect when that temperature exceeds 56°; but that, if moisture be artificially supplied, as by irrigation, to catch-water meadows, that then vegetation will still proceed in proportion to the heat. Third, That when the temperature of the air is between 36° and 41°, the grass will only vegetate with a fifth part of the force that it will when the temperature is 56°. Thus the land that will keep ten sheep per acre, in the latter case, will only keep two in the former. That from 41° to 46° its growth is two-fifths, or double that of its growth when the temperature is under 41°, and it will then keep four sheep instead of two. Again, from 46° to 50°, its growth will rise to seven-tenths, or it will keep on the same ground from five to seven sheep; and from 50° to 56°, it generally — unless assisted by an artificial addition of moisture — arrives at its maximum; but if the month of June be very moist, it will continue to grow with an increase of force up to 60°.

Our climate is very different from that of England. The evaporation from the soil is ordinarily very much more rapid, and the actual amount of moisture in the air is greater, since it is well established that the evaporation is in proportion to the height of the temperature and the extent of water or land surface; that in

the temperate zones it amounts to about thirty-seven inches a year, while in the tropics it rises to from ninety to one hundred inches, and that the atmosphere when at the freezing point contains about a two-hundredth part of its weight of water, while at 52° it contains a hundredth part, or twice as much; at 74°, a fiftieth part, or four times as much, and at 98°, a twenty-fifth part, or eight times as much, and so on in that ratio.

Now, although the mean annual temperature of the two countries is about the same, — it being near London about 48° 5′, and at Boston 48° 9′, — yet the temperature of the growing months of the two countries presents a marked difference, the mean temperature of every one being with us much higher. But the climate of England is proverbially moist, notwithstanding that the mean annual fall of rain near London is only little over twenty-five inches, while the quantity which falls at Boston is over forty-two inches; at Charleston, S. C., over forty-five inches; at Savannah, in Georgia, over fifty-three inches, and at Mobile, Alabama, over sixty inches.

The amount of sensible moisture of the atmosphere is greater in England than here, though the actual amount existing in our atmosphere must exceed that of the atmosphere even in the eastern part of England. Our soil is consequently drier, and unless we have frequent rains vegetation suffers sooner, and the growth of grass is liable to be checked for the want of moisture, and this actually happens more or less nearly every year.

It is plain that the differences in climate that influence and control the growth of the grasses are chiefly moisture and dryness. Moisture must exist either in the soil or the atmosphere. It is also clear that a lux-

uriant growth of grass depends not so much upon the aggregate annual quantity of rain that falls as upon its distribution over the year, and especially over the growing months. A frequent rain in spring, though it may come in small quantities, causes a rapid and succulent growth; but it may be laid down as a well-fixed principle, that the grass crop is better from large quantities of rain falling at once and at longer intervals, — provided it does not come in torrents to prostrate the crop, and that the intervals are not so long as to produce droughts, which are always attended with deleterious effects, — than from smaller quantities falling with greater frequency. The quantity in the latter case will not ordinarily be so great as in the former, but it is more than compensated, it is thought, by the increased value. The fact that grasses grown in a dry season possess greater nutritive and fattening qualities is well known to every practical farmer.

So great is the dependence of the grasses upon heat and moisture combined, that, knowing the results of observations of the thermometer and the rain-gauge in any section, during the three growing months of April, May, and June, one might predict with great certainty the results of the harvest in that section; and, on the other hand, the yield of grass and hay, as stated by practical farmers in different sections of the country, would indicate so clearly and uniformly the excess above the average, or the partial failure of the crop, that a meteorological map of that section might be constructed from their statements.

Before proceeding further in this investigation, it is proper to remark that, in order to bring together the practical wisdom and judgment of some of the best farmers in the country, as well as to be able to present some statistical information in regard to the product of

grass and hay for that season, I directed the following circular to one or more farmers in every town in Massachusetts, and to many individuals in other states, asking for replies from each:

AGRICULTURAL DEPARTMENT, STATE HOUSE,
Boston, Sept. 1, 1856.

DEAR SIR: Will you have the goodness to reply to the following inquiries in reference to the grass and hay crop of your town, according to the best of your judgment and experience? If circumstances prevent your giving it personal attention, will you be kind enough to put it into the hands of some one interested in the subject in your neighborhood who will do me the favor to answer it?

1. What was the estimated yield of grass and hay in your town this season, as compared with others? If above or below the average, how much?

2. What, in your opinion, is the effect of a wet or a dry season on the quality of grass and hay? Is grass grown in the shade as good as that grown in the sun, and what is the difference? [This question embraces the intrinsic value of hay this season as compared with the crops of 1854 and 1855, both comparatively dry seasons, while this has been unusually wet in most parts of the country.]

3. In what month do you prefer to seed down land designed for mowing, and what is the reason of your preference?

4. What varieties of grass-seed do you usually sow for mowing, and what for permanent pasturage, and in what quantities and proportions per acre?

5. Do you prefer to sow grass-seed alone in either case, or with some variety of grain? If the latter, why, and with what grain?

6. Have you cultivated or raised orchard, fowl meadow, or blue joint grasses, and with what result as compared with the yield and value of other grasses?

7. At what stage of growth do you prefer to cut grass to make into English and into swale hay, and what is the reason for your preference?

8. What is the best mode of making hay from Timothy, from redtop, and from wet meadow grass, and at what state of dryness do you consider it made, or fit to get into the barn? [This question embraces, to some extent, the time taken to make it under ordinary circumstances of good weather, &c. This, of course, varies greatly, but some farmers would dry grass cut in the blossom two good hay-days, while others would prefer to cure it less, and get it in on the day it was cut.]

9. Will you state in detail how you make or cure clover; and how, when so cured, it compares in value with other kinds of hay to feed out to farm stock?

10. Have you used hay caps; and if so, with what result, in point of economy? How were they made, and at what cost?

11. Have you used a mowing machine; and if so, what patent, with what power, and with what advantage?

12. At what height from the ground do you prefer to have your grass cut, and why?

13. Have you used a horse-rake; and if so, what patent, and with what advantage?

14. Do you feed off the after growth of your mowing lands in the fall? Do you think it an injury or a benefit to the field to feed it off?

15. Do you top-dress your mowing or pasture lands; and if so, what manure do you prefer to use, at what time, and in what quantities do you apply it?

16. What is the best mode of renovating old worn-out pasture lands?

17. If you have any experience in ditching and draining wet meadow, or ditching or diking salt marsh, will you state the result, and the comparative value of the grass before and after the operation?

18. What are the most valuable varieties of salt-marsh grasses, and how does the hay made from them compare in value with good English hay?

19. Have you any experience in irrigating mowing or pasture lands; and if so, what is the result?

20. Do you prefer to salt your hay when putting into the barn; and if so, what quantity do you use per ton?

21. What do you consider the best mode of destroying couch or twitch grass?

22. What is the best mode of destroying the white weed or ox-eye daisy?

23. Will you give any other details not suggested by the above, which, in your opinion, may be considered important, in regard to this crop; and particularly, if you have experimented with any varieties of grass not in general cultivation, such as lucerne or alfalfa, rye grass, brome grass, Kentucky blue grass, &c., will you state the results as fully as possible? If you have any varieties of grass found to be valuable, but not in general cultivation, the names of which are not known to you, will you send them to this office, where the names will be given?

Very respectfully, your obedient servant,

CHARLES L. FLINT,

Secretary of the Board of Agriculture.

I was indebted to the kindness of many enterprising and intelligent farmers for full and valuable answers

from more than two hundred towns in Massachusetts, and from several different states, and these alone would make a valuable volume of themselves. I can, of course, do no more than extract from them as freely as space will permit, which I shall do at greater length in subsequent chapters.

The range of climate of the United States is so extensive, embracing, we may almost say, the tropical heats on the one hand, and the short summers and severe winters of the Canadas on the other, that the grasses adapted to one region would not even succeed in another. Some grasses which are eminently adapted to sandy soils of a moist climate will not grow on similar arid soils in a drier climate and under a hotter sun.

Blodget, in a valuable article on the climatology of this country, makes the following judicious remarks, which I have somewhat condensed, on account of their length:

As now cultivated (says he), or as relied upon in their natural growths, there are two well-marked divisions of American and naturalized grasses belonging to the dry and humid climates, respectively, of the whole United States. There is another distinction in the temperature of moist climates, as the cultivated grasses do not go into the warmer portions of the country, however humid. The English grasses are the principal ones, embracing the genera *Poa*, *Phleum*, *Festuca*, *Agrostis*, and *Dactylis*; and their most striking peculiarity is the uniform turf they form in growth. Most of these are very well adapted to the climate of the Northern and Eastern States, and of the North Pacific coast; and they here form the great reliance of cultivators. But they also approach their climatic limit here very nearly in both temperature and humidity, and prove their native position to be in a more equable climate. The winter of the upper parts of the New England States and of New York is sometimes destructive from low

temperature alone, and the dry extremes are very injurious, and sometimes absolutely destructive. What precise measures of low temperature destroy these grasses, it is difficult to say; but every alternate year affords some locality in which the cold is so great as to destroy the Timothy and orchard grasses. A continuance of cold for some days below zero of Fahrenheit, and with a minimum of 20° below zero, is undoubtedly certain to be fatal, if the surface is exposed to the air, and is without protection by snow or otherwise.

There is apparently little difference in the hardiness of the principal cultivated grasses in resisting the temperature extremes. Low temperature alone may destroy them in all the elevated portions of the New England States and New York, and in Wisconsin and some parts of Illinois. In most cases the destruction of the three principal grasses occurs at the same time, and no singling out of particular species is remarked.

In the direction of high temperatures there appears no definite limit of this sort, or none depending on single extremes; but all these grasses fail when the mean temperature of the summer months attains to 80°. They have but a variable and uncertain success in Virginia, and in all the states south and westward they are still less reliable, or fail altogether. As they are all perennial in the highest sense, the whole year and all its extremes must be taken into the account. They cannot, as in the cereals, choose a portion of the year only, and adapt their requirement of time to the temperature. In this respect they differ most widely from a very important class of native grasses, which occupy the arid portions of the continent.

In further notice of the limitations of the European grasses, the humidity of climate must be considered. The dry extremes of many of the states where they may generally succeed are quite injurious or destructive in many cases, and this is especially true of the states at the West, where the soil is less tenacious and retentive than at the East. They fail to form the characteristic turf there, and are so much injured by those dry

periods as to become displaced, or to decay gradually, if not suddenly, and to require frequent renewal. This departure from the native climate of these grasses is so great at the plains beyond the Mississippi, as to require a wholly new class; and the European forms there cease, to reäppear only on the coast of the Pacific, in Oregon and Washington Territories, where the English climate is itself in some degree reproduced.

The northern or low temperature limits of these grasses appear nearly identical with those of wheat; and their liability to destruction by the cold of winter alone, without regard to the lifting of the plant from the soil, as in the case with wheat on tenacious soils, does not greatly differ. The grasses will perhaps endure a few degrees lower temperature.

The high temperature limits are nearly the same as with wheat also, taking the month of ripening for wheat as the highest temperature for any month of the year. The range of the English grasses is here little greater than that of wheat, in this definition. As in cultivation, they succeed when the mean temperature for July is 75° to 78°, while the limit of wheat is little above 70° for the same month. In cultivation, without unusual care, they would not differ widely.

There is a possible limit also in low summer temperatures, especially if accompanied with a large amount of moisture in the soil and atmosphere. We are not able to give as precise limits for the English climate in this respect as for wheat, though the grasses we have received from there will not go many degrees lower than wheat for the ripening period, — probably not lower than to 55° for the warmest month of summer, while the same limit for wheat is above 57°. In the United States it may not go so low; though the question is practically unimportant, as we have no districts below 60° for July. In cold and wet localities of the Northern States, the difficulty of preserving these grasses is well known; and, as in other directions of limit, they fail gradually under measures of climatic disadvantage not absolutely destructive.

The contrasted class of grasses adapted to arid climates may advantageously be examined next, and these are all, or nearly all, natives of the interior and western portions of this continent, where they are required. Nutritious grasses of general range over the country of their origin are few in number, while those growing in particular localities, as in wet or sheltered spots, or in others not representing the general surface, are quite numerous everywhere. The principal of the new American grasses is the bunch grass (*Festuca*), the buffalo grass, or small gramma, and the other species of gramma grass (*Bouteloua*).

The range of these is, for the last, or the gramma grass proper, as given by Captain Marcy in his Report on the survey of Red River, "bounded on the north by near the parallel of 36° north latitude, and on the east by the meridian of 98° west longitude. It extends south and west indefinitely, but appears to flourish better in about the latitude of 33° than any other. As there is generally a drought on these prairies from about the first of May to the middle of August, it would appear that the particular varieties of grass growing here do not require much moisture to sustain them."

The buffalo grass, or small gramma, extends at least to latitude 40° in the same longitude, and the associated species called *mezquite*, with this, cover the best portions of the valley of the Great Salt Lake, with the entire country south and west on which rains fall at any season. This whole family is extremely valuable, seeding profusely, and covering every portion of the country where sufficient rain for its growth may be found at any season. In the mountains a winter variety is found remaining fresh, while that of the plains and valleys is dried by the late summer heats. The whole class is admirably adapted to the requirement of the country, as they remain during the warmest months of summer, and until the rains of the next season come on, in a dried form, preserving the nutritive qualities throughout.

The precise time at which the heat and aridity check

its growth, and convert it into dried hay, is not sufficiently known for the different districts. It is probably controlled more by absence of water in the soil, and want of rain, than by temperature — the heat being sufficient for this purpose when the water wholly fails.

Wislizenus, Emory, and Abert, met the smaller gramma, called the buffalo grass, at 38° north latitude, and by their references it might be inferred that this was the northern border at that degree of longitude. But Frémont found it at 40°, on the same meridian, and 98° west longitude, and near the Platte or Nebraska River. It probably extends still further northward, and over much of this great plain to the Missouri. There are no satisfactory notices of the grasses of this great region; but the inference is reasonable that it should range nearly as far as subsistence is afforded to the immense herds of buffalo occupying that area. The recent surveys north of the Missouri were, however, unable to find any considerable amount of it; and Richardson was also unable to find the buffalo grass on the Saskatchawan, though at the time of his visit recent fires had destroyed the growth of all kinds. He remarks a large intermixture of carices with the festuca, and other true grasses, on all the northern portions of the prairie region.

The new forms of valuable grasses found in this great range in our interior deserve the greatest attention in reference to their introduction in field cultivation. The native species of the prairie region, east of the Mississippi, probably cannot be cultivated — they give way too easily at the approach of cultivation, and those of the dry prairies are rarely found in seed. The turf of this prairie growth is very strong and enduring; and in the native state these are valuable grasses, well adapted to the intermediate climates in which they occur, where the humid and dry conditions pass into each other by gradual transition. These range over most of the country of the upper Missouri, as well as on the prairies eastward.

There is a large district in the United States deficient

in adaptation to our present cultivated grasses, to which it may be possible to bring those of the interior ultimately. The prairie districts of the states bordering the Mississippi, and the principal portion of the Southern States, greatly need some better adaptations both to their soil and climate. The new grasses of the southwest would probably not find a congenial climate in the Southern States, because of the excess of rain and of atmospheric humidity; but for the drier portions of the states in the upper Mississippi valley they may be found well suited. Some success has already attended efforts to introduce them.

They are perennials of as great endurance in the turf, apparently, as the English grasses, though they spread very slowly by the expansion of the root, and are reported to leave the centre of the concentric tufts in which they grow, open, as by decay of the original root. But all the gramma and associated grasses produce seed largely, and under cultivation they might become all that could be desired as field grasses.

In California valuable native grasses exist, in part of these and in part of other genera. There the climate is even more extreme in its contrasts, and some of the valuable grasses appear to be annuals. The bunch grass (festuca) is abundant on the upland slopes and valleys, and it is there, as everywhere, of great value. Whether this may be cultivated is more problematical than in case of the gramma, and there has probably been no attempt at it yet. In the lower plains and valleys oat grasses and annuals form a larger share; but whether they are exclusive occupants is not sufficiently known. There is certainly a tendency towards a less permanently perennial character in most of the grasses of the South and West, and they approach the higher gramineaceous forms which constitute the grains more nearly than those of northern origin, and the natives of humid climates.

Bryant, in a work on California some years since, says of the grasses of that country: "The varieties of grasses are greater than on the Atlantic side of the con-

tinent, and they are also far more nutritious. I have seen seven different kinds of clover" (not analogous to the true clovers), "several of them in a dry state, depositing a seed upon the ground so abundant as to cover it, which is eaten by cattle, horses, and other animals, as corn and oats, when threshed, would be. All the grasses — and they cover the entire country — are heavily seeded, and when ripe are as fattening to stock as other grains."

The grains are, indeed, the product of the great continental interior of the Eastern continent, and belong to arid climates wholly in their original state. By analogy, we might look for high graminaceous forms in the interior of this continent, but it is not known that any bread grain has had its origin in climates similar to our own. Maize is one of the grasses or higher graminaceous plants; but this had a tropical origin, and it is, wherever grown, of a purely tropical type.

The grasses of the American interior are singular in all respects, and, so far as known, have no analogous forms in Asia. Too little is known, however, of the nutritious grasses of the interior of the Old World, to institute a comparison of its forms found in arid climates with those produced here. It may be briefly referred to as a most desirable point for investigation, however, and the continuance of the examination respecting climatic adaptation for the great interior area of our agriculture is urged by the strongest consideration of both private and national economy.

Frémont remarks of the value of these indigenous grasses, as found in his earlier expedition to the Great Basin and to Oregon: "The grazing capabilities of this region are great, and in the indigenous grasses an element of individual and national wealth may be found. In fact, the valuable grasses begin within one hundred and fifty miles of the Missouri frontier, and extend to the Pacific Ocean. East of the Rocky Mountains, it is the short curly grass, on which the buffalo delight to feed (whence its name of *buffalo grass*), and which is still good when dry and apparently dead. West of the

mountains it is a larger growth, in clusters, and hence called *bunch grass*. This has a second or fall growth. Plains and mountains both exhibit them, and I have seen good pasturage at an elevation of ten thousand feet. In this spontaneous product the trading or travelling caravans can find subsistence for their animals; and in military operations any number of cavalry may be moved, and any number of cattle may be driven, and thus men and horses supported on long expeditions, and even in winter in the sheltered situations."

Little allusion has so far been made to the grasses fitted to the climate of the humid districts of the South. These have an essentially different requirement from either the arid regions of the interior and south-west, or the debatable ground between these and the other extreme in the cool and humid climates of the north and east. From these last they of course differ still more widely.

Experiment has very satisfactorily proved the impossibility of carrying the English and northern grasses under the excessive temperatures found in the Southern States. Both the temperature and humidity, or the joint effect of these rather, preclude their growth entirely, though it is difficult to say whether either condition alone would so preclude it. Comparing the more humid climates of England with those of equally high saturation of the South, we might infer that temperature alone caused the difference; but positions in the states near the 39th parallel of latitude have temperatures in summer quite equal to those near the Gulf, and yet permit a considerable success in the growth of English grasses.

Agriculturists at the South have scarcely been successful in the attention hitherto given to the introduction of valuable grasses. Their cultivation is less a necessity of plantation management than of farm occupation, as at the North, and it only becomes imperatively such when the preservation of the soil from washing and exhaustion becomes necessary. Such is, at present, the state of much of the cultivated area at the South, and it

is of the first importance to know whether the permanent grass covering of the soil may be attained by any possible means.

The normal range of the grasses, strictly speaking, is not so far south. Their native climates are north of the native grain districts, and in cooler and more humid atmospheres; while the southern part of the United States has a tropical summer, and lies on the opposite side of the climatological limit. We cannot anticipate success in grasses taken from the colder extreme in this opposite position, and probably very little for those adapted to dry climates, whether warm or cold. The source should be tropical or semi-tropical; and such has, indeed, been the origin of many species introduced and cultivated to some extent at the South. The Guinea grass (*Sorghum vulgare*) is of this sort, and the Bermuda grass (*Cynodon dactylon*). The last is much like the cane in its root and habit of growth, and both are purely tropical forms. The sugar-cane is itself frequently cultivated as a grass, with success, and all these are more easily cultivated as forage plants, to be used for pasturage and soiling only, than as dried in the form of hay. The succulent character of the growth scarcely permits curing; and the mixture of "winter grasses," or the coarser festucas often cultivated there for their winter's produce, of which the gramma grass and the technical "winter grass" are the principal, will, ultimately, be necessary to answer the end proposed in their grass cultivation, and indispensable, indeed, to their agricultural prosperity. The gramma grass of Texas and New Mexico may bear a considerable extension over the drier soils and least humid portions of the South, and it has already been introduced with some success.

It has been found extremely difficult to form a close turf or sward below the latitudes of the more equable distribution of rain; and this is the case south of Baltimore, in latitude 39° 18′, owing to the excessive and often long-continued heat and drought. Even lucerne,

which grows in great perfection in the south of France, is very unreliable south of Philadelphia, from the heat, and north of it from the cold.

The growth of grass south of the parallel of 39° is similar to that on the dry and arid sands in higher northern latitudes. Most of the higher English grasses fail, in such situations, to form a close turf, and give place to the tufted or jungle grasses, or to such as refuse to grow in close companionship with others. In going west from the Mississippi River a close-cultivated turf is rare; and the same is the case, as already seen, south of Washington, or perhaps south of Baltimore, and of the line running west from there to the Mississippi. The clovers may be cultivated to some extent; but, though valuable as forage plants, they become poor substitutes for the close and beautiful sward of a cooler climate. In California several species of *medicago* are highly esteemed, and are known under the general term of "California clover."

It must be evident, from what has been said, that the climate of the United States is not so well adapted, as a whole, to bring the higher grasses to perfection, as that of England. A moist and equable climate is best adapted to all this class of plants, — that is, to promote their rich luxuriance of growth. The nutritive qualities of grasses grown under greater heat and a drier climate are, undoubtedly, superior; and this is a fact familiar to every observing farmer. Grass grown in a wet season, or very moist climate, bears a striking resemblance to that grown under the shade of trees.

The remarks of a practical farmer of Kentucky well express the general estimate made by most farmers in reply to the second question proposed in the circular given on a preceding page. "Just so far," says he, "as there is shade, is the grass deficient in saccharine and

nutritious qualities; that grass which is most exposed to the sun being best. Woodland pastures will keep young stock growing, and old ones on foot, but will not fatten them. A three-year-old Durham will get 'stall fat' in a year on *open* blue grass."

A farmer of Massachusetts says: "Grass grown in the shade is lighter, and does not contain so much nutriment. Wet seasons increase the weight and bulk of the crop; but the same weight does not contain the amount of nutritive matter of hay raised in a dry season." And another: "Hay grown in a dry season contains more nutriment. This is particularly noticeable in the condition of cattle in the spring following a dry season. I do not consider grass grown in a dense shade worth over half price." "From an experience of fifty years in making hay, and thirty-five in feeding it out and selling it," says an intelligent practical farmer, "I should say that in a wet season I never found anything like so much heart or nutriment in hay as in a dry one. Grass grown under a thick, shady tree is not worth one-half as much as that grown in the sun. The grass this year (1856) was well set in the spring, and grew very quick when the warm weather came on; but still we had much good, warm sun to bring it to maturity, and I think it will spend pretty well, but probably not quite as well as the same bulk last year."

It is not necessary to multiply the authorities of practical farmers on this point, since they uniformly coïncide with the testimony given above; and it may be regarded as fully established as the result both of scientific investigations and of practical experience, that both the quantity and the quality of grass are in proportion to the heat or sunlight and the moisture in which it is grown.

What has been said will explain the allowance which

it may be proper to make in the analyses of grass grown in a climate of less heat and less sunshine than our own. It will also lead to the conclusion that our own grasses, grown on low, moist lands, are neither so sweet nor so nutritious as the same species grown on higher and drier soils; and it is a fact which has fallen under the observation of practical farmers, that the grasses on low lands do not produce so much nor so good a quality of milk, nor so much fat in animals, as the same species of grass grown on upland soils.

But, though we cannot boast of so luxuriant a growth of the grasses as other and more favorable climates, we have, as already remarked, at least some compensations. With the necessities of our rigorous northern winters to provide for, the English summers, with their daily and almost hourly rains, would make it extremely difficult to put in the proper stores of winter food for our stock.

It is a curious fact that the destruction of the grasses from the colds of winter is less to be apprehended in some of the higher northern latitudes than in somewhat milder climates. In the northern and eastern portions of Maine, for instance, the snow generally falls before the frost has penetrated to any great depth; and it usually lasts, often very deep, till the spring opens; and as soon as it is gone the grass is green and luxuriant, and the sod ready for the plough; while in Washington the cultivated grasses are absolutely destroyed both by the colds of winter and the heats of summer; and this very frequently happens, — more frequently than in higher latitudes, and where the actual severity of the cold is greater. It is the frequent alternation of cold and warmth, rather than the low degree of temperature, that is most injurious to vegetation.

We have already seen that in the Middle States some

of the species of *Poa* — such, for instance, as the Kentucky Blue grass (*Poa pratensis*) — appear to take the lead, as among the most important pasture grasses. This species is known as Green grass in Pennsylvania. It is said also to bear the hottest summers of Tennessee, where it is reckoned one of the best grasses, while it grows with the utmost luxuriance in Kentucky, and as far north as Indianapolis, in wooded pastures, and forms a large proportion of the turf even in New England. This and nearly allied species are not adapted, however, to alternate husbandry.

Beyond the limits of these on the south, the Gramma, the Guinea, and the Bermuda grasses, take the lead; while the sugar-cane itself is not unfrequently cultivated as a fodder plant. Some of the festucas, also, grow well, and withstand the hot climate, and form a valuable winter feed for cattle. They are known there by the term "winter grass." In many sections, also, the Common Reed Grass (*Phragmites communis*) and its allied species cover the low grounds, and afford a large amount of nutritive herbage, till cut off by the frosts; while on the dry plains west of these sections, the gramma grasses, or, as they are often called, the Mezquite (one or more of the species of *Bouteloua*), become the most valuable of the native species found in a belt of country with about the thirty-fifth parallel as its centre. The Buffalo grass, or small gramma, is one of these species found as far north as the fortieth parallel.

The gramma grasses are valuable chiefly as being adapted to a hot climate. Their growth is mainly in the rainy season, and they seed abundantly as the dry season approaches. In the section of country west from the State of Arkansas, the rainy season is in the spring; in the northern part of Mexico, it is in summer; in southern Texas, in autumn, and in some parts of New

Mexico, in winter; so that the period of greatest growth of the gramma or muskit grasses is various, being regulated chiefly by the rains; but even when dry they form a very nutritive food for stock.

On the western prairies but few valuable native grasses are found. While they are allowed to grow wild they cover the soil with a pretty close growth; but when the turf is once broken it is very difficult to reform it with the better English grasses, except around low spots, or places well supplied with moisture.

With respect to the climatic range of the grains, such as wheat and Indian corn, and others spoken of in Chapter II., little need be added in this connection. With the exception of Indian corn, the grains are exotics, and for the most part natives of a moist climate, or came to us naturalized in a climate much more moist than our own. They flourish best, therefore, in the cooler parts of this country, though their range of climate, with the exception of rice, is very great. In the more southern portions they ripen before the hot, dry weather comes on. The English grasses, as we have already seen, are destroyed by it.

For Indian corn, which is a tropical plant, there is no southern limit of growth in this country, while the northern limit to its profitable culture may be stated in general at the point where the mean temperature is about 68° Fahrenheit. The flexibility of its organization is such that while in a warm climate it may grow for a period of four or five months, or even more, in colder latitudes it will ripen in two and a half or three months, and rarely requires over four months. A small variety is cultivated as far north as fifty-one degrees of latitude, on the Red River. It requires great summer heats, but will often succeed well in the northern states with a cool and rainy summer, provided there is a week or two

of hot weather in the month of June or early in July, and a late fall with warm weather at the period of ripening. It will not endure a mean temperature below 65° in the growing season, but the morning and evening temperature may be low, provided the midday heat is sufficient to carry up the mean of the month beyond that point. This high curve of heat at midday is so essential that, without it, there will be no formation of saccharine matter in the plant, nor will it mature; while with it the temperature of the night may be quite low. This is one, and almost the only, condition absolutely essential to its successful culture, and this condition is fulfilled in almost every part of the country, except the mountainous districts above mentioned. As a means of reference, the following may be given as the results of observations at the Observatory at Cambridge during the growing months of 1854, 1855, and 1856, which do not vary much from the mean or average temperature of these months in any series of years.

The observations were made four times a day, — at sunrise, 9 A. M., 3 and 9 P. M., the latitude being 42° 22′ 48″, the longitude 71° 1′.

Months.	Mean Temp. in 1854.	Rain in 1854.	Mean Temp. in 1855.	Rain in 1855.	Mean Temp. in 1856.	Rain in 1856.
		Inches.		Inches.		Inches.
March, ...	33°.1	2.949	32°.31	1.159	26°.98	0.970
April, ...	42°.9	4.842	44°.08	3.990	45°.82	3.732
May, ...	57°.7	5.453	53°.40	1.501	52°.55	6.732
June, ...	65°.9	3.585	65°.48	3.581	68°.08	2.869
July, ...	72°.9	3.239	72°.24	4.845	72°.76	4.243
August, ...	68°.6	0.351	67°.31	2.270	67°.31	14.981
September, ...	61°.4	4.360	61°.45	1.216	62°.98	—

The season of 1858 was remarkable in most parts of New England as a season of frequent rains and cool

weather in July and August, and the farmers generally predicted a failure of the corn crop, and wondered all the summer at the luxuriant growth of this plant. The secret of it undoubtedly was that the last week of June and the first week of July were excessively hot, though the rest of the season was unusually cool and moist. The ground had become warmed to a great depth, and this was sufficient to give the plant a rapid growth through the rest of the growing season. Every part of the country is, therefore, adapted to Indian corn, with the exception of the higher mountainous parts of New England, and northern New York, and northern Wisconsin and Minnesota.

There are great staples of the Southern States more profitable, it is true, owing to their extremely limited range of climate; but, as a plant for the whole country, no other can compare with it in importance.

The climatic range of wheat and barley is still greater, for both grow successfully at small elevations above the level of the sea, on the borders of the tropics, while wheat may be cultivated as far north as 60°, and the culture of barley extends to the polar circle. The climatic range of oats does not materially vary from that of wheat.

But, though the absolute range of climate for wheat is greater than that of Indian corn, there are more local conditions which affect it, and hence its most profitable limit of cultivation may not be much greater.

The districts of this country which correspond most nearly to the great wheat-growing sections of Europe may be found in central New York, Pennsylvania, and a part of Maryland, and a section through the states lying immediately south of the great northern lakes, including the prairie lands west from Lake Michigan. In these sections the mean temperature of

summer ranges from 68° to 71°, and the grain ripens usually in July. In the extreme southern states May is the harvest month, and the mean temperature of that is from 67° to 70°. In Virginia the wheat harvest extends into June, and the mean temperature is from 63° to 65° for May, and from 68° to 72° for June, while in central New York the harvest extends into July, and the mean temperature of the former month there is 64°, and that of the latter 69°; and in Illinois, where the wheat harvest ends in June, the temperature is below 70°, while the temperature of May is from 60° to 62°.

As already intimated, many local modifications are required in taking an account of the influence of climate on the growth of wheat. A low temperature for the growing months, which may be a rare exception, will of course affect it. The summer of 1853 in England, for instance, was about two degrees below the average of mean temperature, and the consequence was that the wheat crop fell off from a third to a half. July and August of that year gave a mean temperature of from 57° to 59°, while 60° are required there to insure a good harvest. The climate of our Pacific coast more nearly resembles the climate of western Europe than it does that of our own Atlantic coast.

The following statistics of the mean temperature of the months of growth and ripening of wheat and similar grains, in wheat sections of this country and in Europe, will be valuable for reference:

	April.	May.	June.	July.
Gettysburg, Pa., . . .	50°.3	60°.6	69°.2	74°
Rochester, N. Y., . . .	44°.7	56°.1	65°.0	69°.9
Oberlin, Ohio, ...	48°.1	59°.4	67°.6	75°.5
Milwaukie, Wis., . . .	40°.7	51°.3	64°.8	69°.8
	March.	**April.**	**May.**	**June.**
Chapel Hill, N. C., . .	51°.1	59°.5	67°.3	74°.7
Athens, Ga., ...	55°.0	64°.0	69°.1	75°.4

	March.	April	May	June.
Nashville, Tenn., . . .	49°.4	61°.9	68° 3	76°.5
Fort McKavett, Tex., .	57°.4	66°.2	72°.2	74°.9
Sacramento, Cal., . .	53°.2	59°.5	65°.2	71°.7
	May.	June.	July.	August.
York, Eng., ...	57°.0	61°.2	62°.4	63°.5
Aberdeen, Scotland,	52°.3	56°.7	58°.8	58°.0
Epping, Eng., ...	56°.6	60°.0	62°.2	60°.9
Dantzic, Baltic, . . .	52°.1	59°.3	63°.6	62°.9
Konigsberg, Baltic, .	51°.9	57°.4	62°.6	61°.7
Moscow, Russ., . . .	54°.4	62°.4	66°.4	63°.1
Bucharest, Russ., . .	56°.3	62°.5	68°.1	65°.2
Kasan, Russ., ...	51°.5	61°.3	64°.8	60°.8
	March.	April.	May.	June.
Beyrout, Syria, . . .	61°.3	65°.3	71°.3	75°.4
Alexandria, Egypt, .	62°.2	67°.0	70°.3	76°.2
Palermo, Sicily, . . .	54°.0	58°.6	64°.8	71°.2

Winter wheat generally succeeds best when the ground is covered with snow; and if this protection is wanting, it is not unfrequently winter killed. It sometimes happens, also, that a covering of snow affects it in such a manner as to destroy it entirely or in part; and this is the case when the snow is too compact, so as to prevent the access of air for a considerable period. On a clay soil the frost often acts mechanically, producing what is called heaving by the frost. Other influences of soil and culture affect the growth of wheat probably to a greater extent than that of Indian corn, and the same applies more or less to the other grains mentioned in the second chapter.

The northern range of these grains, particularly that of barley and rye, is somewhat greater, and the difference may be stated at about five degrees of mean temperature, which would embrace several degrees of latitude. Barley grows further north than any other, but both barley and rye will endure cooler and shorter summers, and a somewhat poorer soil.

Oats succeed rather better than wheat in a moist and cool climate, but will not endure frosts like that plant. It may be said, in general, that these grains will not endure a mean temperature of less than 58° for the growing months, in equable climates, and about 65° in more variable ones, with freedom from frosts during a month or two previous to, and during the time of, coming to maturity. Long-continued periods of moisture, united with heat, cause various diseases, as rust, mildew, smut, and other similar injuries.

CHAPTER VIII.

SELECTION, MIXTURE, AND SOWING, OF GRASS-SEEDS.

In general, too little attention is paid to the selection of seeds, not only of the grasses, but of other cultivated plants. The farmer cannot be sure that he has good seed unless he raises it for himself, or uses that raised in his neighborhood. He too often takes that which has passed through several hands, and whose origin he cannot trace. Bad or old seed may thus be bought in the belief that it is good and new, and the seller himself may not know anything to the contrary. The buyer, in such cases, often introduces weeds which are very difficult to eradicate.

The temptation to mix seeds left over from previous years with newer seed is very great, and there can be no doubt that it is often done on a large scale. In such cases the buyer has no remedy. He cannot return the worthless article, and the repayment of the purchase money, even if he could enforce it, would be but poor compensation for the loss of a crop.

The seeds of some plants retain their vitality much longer than others. Those of the turnip, for instance, will germinate as well, or nearly as well, at the age of four or five years, as when only one or two years old; they are thought to be better at two years old than one. But the seeds of most of the grasses are of very little

value when they have been kept two or three years; and hence the importance of procuring new and fresh seeds, and guarding against any mixture of the old and worthless with the new as carefully as possible.

It is easy to tell whether the germinative power of grass or any other seed still remains, by the following simple method; and, if the buyer should be willing to try it, he might purchase only a small quantity at first, and afterwards obtain his full supply with more confidence, if the trial showed it to be good. Take two pieces of thick cloth, moisten them with water, and place them one upon the other in the bottom of a saucer. Place any number of seeds which it is desired to try upon the cloth, spreading thin, so as not to allow them to cover or touch each other. Cover them over with a third piece of cloth, similar to the others, and moistened in the same manner.

Then place the saucer in a moderately warm place. Sufficient water must be turned on, from time to time, to keep the three thicknesses of cloth moist, but great care must be taken not to use too much water, as this would destroy the seed. There should be only enough to moisten the cloths, and not enough to allow any to stand in the saucer. Danger from this source may be avoided in a great measure, however, by tipping up the saucer so as to permit any superfluous water in it to drain off. The cloth used for covering may be gently raised each day to watch the progress of the swelling or the moulding of the seeds. The good seed will be found to swell gradually, while the old or poor seed, which has lost its germinating power, will become mouldy in a very few days.

In this way, also, any one can judge whether old seed is mixed with new. The latter will germinate much more quickly than the former. He can, moreover, judge

of the quantity which he must sow, since he can tell whether a half, or three-fourths, or the whole, will be likely to germinate, and can regulate his sowing accordingly. The seeds of the clovers, if they are new and fresh, will show their germs on the third or fourth day; other seeds will take a little longer; but, till they become coated with mould, there is hope of their germinating. As soon as the mould appears it is decisive, and the seed that moulds is worthless.

It is difficult to over-estimate the importance to the farmer of a good selection and proper mixture of grass-seeds for the various purposes of cultivation, for mowing, for soiling, for permanent pasturage, or for an alternate crop.

Doubtless the varieties of seed usually sown in this country, consisting almost exclusively of Timothy and redtop, with a mixture of red clover, are among the best for our purposes, and their exclusive use is, in a measure, sanctioned by the experience and practice of our best farmers; yet it would seem very strange, indeed, if this vast family of plants, consisting of thousands of species and varieties, and including, as already intimated, nearly a sixth part of the whole vegetable kingdom, could furnish no more than two or three truly valuable species.

When we consider, also, that some species are best adapted to one locality, and others to another, some reaching their fullest and most perfect development on clay soils, and some on lighter loams and sands, we cannot but wonder that the practice of sowing only Timothy and redtop on nearly all soils, — clays, loams, and sands, indiscriminately, — both on high and low land, should have become so prevalent.

It is equally remarkable that while but very few of our grasses, and these for the most part species peculiar

to sterile soils, flourish alone, but nearly all do best with a mixture of several species, it should so constantly have been thought judicious to attempt to grow only two prominent species together, with merely an occasional addition of an annual or a biennial clover, which soon dies out. When this course is pursued, unless the soil is rich and in good heart, the grass is likely to grow thin and far between, producing but half or two-thirds of a crop; whereas, the addition in the mixture of a larger number of species would have secured a heavier burden, of a better quality. These considerations, it seems to me, indicate the true direction in which the farmer who wishes to "make two spires of grass grow where one grew before," *without impoverishing the soil*, should turn his attention.

I hold this proposition to be indisputable: that any soil will yield a larger and more nutritious crop if sown with several kinds of nutritious grasses, than when sown with only one or two species. Indeed, it is a fact well established, by careful experiment, that a mixture of only two or three species of grasses and clover will produce a less amount of hay than can be obtained by sowing a larger number of species together. There may be some exceptions to this rule, as in cases where the yield of Timothy and redtop, owing to the peculiar fitness of the soil for them, is as great as can stand on the ground on which they grow.

But it is nevertheless true, that if we sow but one kind of grass, however abundantly the seed may be scattered, or on whatever soil it may be, or under however favorable influences, only a part of the plants will flourish; vacant spaces will occur throughout the piece, which will be filled up after a time by grasses of an inferior quality, weeds, or mosses. This is the case in some degree, also, where only two, or a small number, of species

are sown; while, if a mixture made up of a larger number of kinds of seed is used, the plants will cover the entire surface, and produce a far better quality of herbage.

In sowing such a mixture of several different species, we do but follow nature, who, after all, will generally be found to be the best teacher; for, wherever we cast our eyes over an old, rich, permanent pasture, we ordinarily see from fifteen to twenty species of grass or forage plants growing in social profusion, and often many more species. If the soil be very poor, as a cold, hard clay, or a barren sand, perhaps two or three varieties will suffice; but on good soils a larger number will be found to be far more profitable.

Especially is this the case where the land is to be left in grass for some years, and eventually to be pastured, as is often done in New England; for it is then desirable to have grasses that reach their maturity at different times, as a constant succession of good feed throughout the season may thus more surely be obtained. It is well known that there is no month of spring or summer in which some one of the grasses does not attain to its perfection, if we except the month of March, and even this brings up a luxuriant growth in the more southern latitudes. For good soils, eight or ten species of the grasses, or six or eight of the grasses proper, and one or more of other herbage plants, would probably be found to be profitable.

I am aware that the prevailing practice is decidedly against the use of anything but Timothy, redtop, and clover, and that very large crops of these grasses are often raised; but it is nevertheless true that we obtain, on an average, less than a ton to the acre, while, with the same culture and a larger number of species, we ought to get double that quantity.

Before proceeding to consider the proportions in

which the different species should be mixed, it may be well to refer to the mode generally adopted for estimating the quantities of seeds and their relative weight. And I may remark here that the prevailing practice of buying and sowing grass-seeds by measure, rather than by weight, seems injudicious, to say the least. It is well known that old or poor seed weighs less than that which is fresh and new. Now, if a farmer buys by weight, even if he does get an old or inferior quality of seed, he gets a much larger number of seeds, and this larger quantity of seed which he receives for his money may make up for the inferior quality, and he will have a larger number of seeds capable of germination than he would have if he bought by measure. It is to be regretted that it has become so nearly universal to purchase by measure, though, as this course is for the seller's advantage, it may be difficult to change the custom.

The following table, containing the weight per bushel of the seeds of the most important agricultural grasses, has been prepared chiefly from a valuable treatise on the grasses, by the Messrs. Lawson, of Edinburgh, who have paid much attention to this subject, and whose experience and observation in this department have probably been larger and more extensive than those of any other seedsmen.

This table will be found to be exceedingly valuable for reference.

Column 1 contains the common names of the grasses.

Column 2, the average number of pounds in a bushel of the seeds.

Column 3, the average number of seeds *in an ounce.*

Column 4 shows the depth of soil, in inches and fractions of an inch, at which the greatest number of seeds germinate.

Table XIV.—Weight of Grass-seeds, and Depth of Covering.

1.	2.	3.	4.	5.	6.	7.
Whitetop,	13	500,000	0 to ¼	½ to ¾	1	.65
Redtop,	12	425,000	–	–	–	.63
Tufted Hair Grass,	14	132,000	0 to ½	¾ to 1	2¼	.65
Meadow Foxtail,	5	76,000	0 to ½	1 to 1¼	2¼	.57
Sweet-scented Vernal,	6	71,000	0 to ½	1 to 1¼	2	.45
Tall Oat Grass,	7	21,000	½ to ¾	1½ to 1¾	4	–
Slender Wheat Grass,	10	15,500	0 to ¼	½ to ¾	2	–
Crested Dog's-tail,	26	28,000	–	–	–	–
Orchard Grass,	12	40,000	0 to ¼	¾ to 1	2¼	.29
Hard Fescue,	10	39,000	0 to ¼	¾ to 1	2¼	–
Tall Fescue,	14	20,500	0 to ¼	1 to 1¼	2¾	.52
Sheep's Fescue,	14	64,000	0 to ¼	¾ to 1	2	.65
Meadow Fescue,	14	26.000	0 to ½	¾ to 1	2½	.60
Slender Spiked Fescue,	15	24,700	–	–	–	–
Red Fescue,	10	39,000	–	–	–	–
Reed Meadow Grass,	13	58,000	¼ to ½	¾ to 1	2¼	.30
Common Manna Grass,	15	33,000	–	–	–	.35
Meadow Soft Grass,	7	95,000	¼ to ½	¾ to 1	2½	.73
Italian Rye Grass,	15	27,000	0 to ¼	1 to 1¼	3¼	–
Perennial Rye Grass,	18 to 30	15,000	¼ to ½	1½ to 1¾	3½	.50
Millet Grass,	25	80,000	¼ to ½	1 to ¼	2¾	.38
Reed Canary Grass,	48	42,000	–	–		.32
Timothy,	44	74,000	0 to ¼	¾ to 1	2	.50
Wood Meadow Grass,	15	173,000	–	–	–	.31
June or Spear Grass,	13	243,000	–	–	–	.57
Rough-stalked Meadow,	15	217,000	0 to ¼	½ to ¾	1½	.72
Beach Grass,	15	10,000	½ to 1	1½ to 1¾	4	–
Yellow Oat Grass,	5½	118,000	0 to ¼	¾ to 1	2	–
Red Clover,	64	16,000	0 to ½	1¼ to 1½	2	–
Perennial Clover,	64	16,000	0 to ½	1¼ to 1½	2	–
White Clover,	65	32,000	0 to ¼	½ to ¾	1½	–
Lucerne,	60	12,600	–	–	–	–
Sainfoin,	26	10,280	¾ to 1	2 to 2¾	4¼	–

Column 5 shows the depth of soil, in inches and fractions of an inch, at which only one-half of the seeds germinated.

Column 6 shows the least depth of soil, in inches or fractions of an inch, at which none of the seeds germinated.

Column 7 shows the average percentage of loss in the weight of the grass, in making into hay, when cut in the time of flowering.

The weight of seeds varies, of course, somewhat from that stated in the above table, according to their quality. Those given in the table are the average weights of good, merchantable seed. In some states, as in Wisconsin, for instance, the legal weight of Timothy-seed is forty-six pounds to the bushel; in others, it is forty-four. The weight of a bushel will depend in part, of course, upon the thoroughness with which it is cleaned. The seeds of the different varieties of rye grass differ in weight, varying from twenty to thirty pounds per bushel; but the average is from twenty to twenty-five pounds.

The number of seeds of each species in a pound may be found, of course, by multiplying the numbers in column 3 by sixteen, the number of ounces in a pound. It is obvious, however, that these numbers must vary, like the number of pounds in a bushel; for it is evident that the lighter the seed, the greater will be the number of seeds in a pound. The numbers stated are the average obtained by careful and repeated trials, and they may be relied on as the average of well-cleaned seed.

The results stated in columns 4, 5, and 6, were obtained by careful experiment, and will be found to be very suggestive.

The fact that the soil used in the experiments to ascertain the proper depth of covering was kept moist during the process of germination, though freely exposed to the light, accounts for the large number of seeds germinated without any covering whatever. In ordinary field culture some slight covering is desirable; but the figures in column 6 show the important fact

that in our modes of sowing and covering there must be a great loss of seed from burying too deep, though the depth should be governed somewhat by the nature of the soil, as its usual moisture or dryness.

I have already expressed my opinion that we limit our mixtures to too few species, thus failing to arrive at the most profitable results; and have said that in a piece of land seeded with one or two favorite grasses only, small vacant spaces will be found, which, in the aggregate, will diminish very considerably the yield of an acre, even though they may be so small as not to be perceived. It might be thought that this could be avoided by putting into the ground a very large number of seeds. But a knowledge of the quantities of seed ordinarily used for sowing, and an inquiry as to the number of plants necessary to cover the ground with a thick coating of grass, will show that this is not the case.

I have in my possession letters from some of the best farmers in various parts of the country, in which they state it to be the prevailing practice to sow a bushel of redtop, a half-bushel of Timothy, and from four to six pounds of red clover, to the acre. Some of them vary the proportions a little, as by the use of one peck of Timothy and a larger quantity of clover; but the general practice is to use nearly the quantities stated, some even using a considerably larger quantity. Now, if we examine the table, we shall find that in an ounce of redtop-seed there are 425,000 grains; in a pound, there are over 6,000,000 seeds; in a bushel, or twelve pounds, there are over 80,000,000 seeds. Now, suppose the farmer takes only one peck of Timothy-seed to mix with it. In an ounce of Timothy grass-seed there are 74,000 grains. In a pound there are over 1,000,000 grains. In eleven pounds, or a peck, there are over 13,000,000 seeds; and, if we take but four

pounds of clover, which is below the average quantity used, we shall find by the same process that we have over 1,000,000 seeds. If now we add these sums together, we shall find that we have put upon the acre no less than 95,000,000 seeds! This gives about fifteen seeds to the square inch, or about 2,000 seeds to the square foot!

Again, one of the most intelligent farmers in the country, a practical man, uses five pecks of redtop and twelve quarts of Timothy to the acre for mowing lands, and an addition of five pounds of white clover for pastures, making no less than 124,000,000 seeds per acre. There must be, evidently, an enormous waste of seed,

TABLE X. — AVERAGE NUMBER OF PLANTS AND SPECIES TO THE SQUARE FOOT OF SWARD.

CHARACTER OF THE TURF.	Whole number of plants on the square foot.	Natural grasses.	Clover, and other plants.	Distinct species.
1. A square foot taken from the richest natural pasture, capable of fattening one large ox or three sheep to the acre, was found to contain	1,000	940	60	20
2. Rich old pasture, capable of fattening one large ox and three sheep per acre, .	1,090	1,032	58	–
3. Another old pasture contained	910	880	30	12
4. An old pasture of a damp, moist, and mossy surface, ...	634	510	124	8
5. A good pasture, two years old, laid down to rye grass and white clover, ...	470	452	18	2
6. A sod of narrow-leaved meadow grass (Poa angustifolia), six years old, ...	192	–	–	1
7. A sod of meadow foxtail by itself, six years old, ...	80	–	–	1
8. Rye grass by itself, same age, ...	75	–	–	1
9. Meadow, irrigated and carefully managed,	1,798	1,702	96	–

or an extensive destruction of the plants; for, if we take nature for our guide, we shall not find anything like that amount of plants on an inch or a foot of our grass lands. Let us see, from a very careful trial, how many plants and how many species are to be found in a square foot.

These plants, in each instance, were counted with the utmost care, by a farmer now living in Massachusetts, then in the employ of Mr. Sinclair, and the correctness of his results may be relied on.

Now, it is a well-known fact that the sward of a rich old pasture is closely packed, filled up, or interwoven, with plants, and no vacant spaces occur. Yet we see, from the above table, in a closely-crowded turf of such a pasture, only one thousand distinctly-rooted plants were found on a square foot, and these were made up of twenty different species. They are seen in Table X.

The soil should be supplied with a proper number of plants, else a loss of labor, time, and space, will be incurred; but, however heavily seeded a piece may be with one or two favorite grasses, small vacant spaces will occur, which, though they may not seem important in themselves, when taken in the aggregate will be found to diminish very considerably the yield of an acre. Undoubtedly some allowance should be made for the seeds and young plants destroyed by insects, birds, and various accidental causes; but, even after all deductions for these, we see that there is no deficiency in the quantities of seed used, and the imperfectly covered ground cannot be explained in this way.

The above table is also important as an illustration of the truth of my general proposition. It shows that in those pastures where few species were found together, whether in old, natural pastures or in artificial meadows, the number of plants on a given space was

proportionally small. Sinclair, too, who had observed carefully and extensively, writes on this point, in regard to the practice of over-seeding, as follows: "When an excess of grass-seed is sown, the seeds, in general, all vegetate; but the plants make little, if any progress, until, from the want of nourishment to the roots, and the confined space for the growth of the foliage, a certain number decay, and give the requisite room to the proper number of plants; and that will be according as there are a greater or less variety of different species of grasses combined in the sward."

It is proper to make some allowance for bad seed, it is true; but our practice throughout the country is defective and uneconomical. In the examination of the rich and productive pasture turf, from twelve to twenty species were found closely mixed together, and there were six or seven plants to the square inch. We sow seed enough, frequently, for fifteen plants to the inch, but rarely obtain above two or three, and generally even less than that, owing to the limited number of species.

The difficulty of procuring the seed, and its expense, have been the strongest objections to the use of many species. A demand for these species, however, would soon remove this difficulty, and varieties would be kept for sale in every seed-store in the country, and at a reasonable price. When it is considered that the additional expense of sowing a field or permanent pasture with a greater number of species will be, comparatively, very small, while the additional yield will be proportionably large, — if the result is as favorable as the opinion of many who have made the trial would lead us to expect, — every farmer must admit that it is for his interest to try the experiment on a small scale, at least.

It will be evident, after a moment's reflection, that

very different mixtures, both as regards the species and the relative quantities of each, will be desirable for different soils; that different mixtures would be required for alternate cropping or laying down land for only a year or two, and for permanent pasture. In our practice it is most common to seed down for some years, and not unfrequently this is done with the design of cutting the grass for hay for a few years, and then pasturing the field, in which case our seeding down assumes the character of laying down for permanent pasturage.

Equally good, but very different mixtures, might be made, also, for the same soils, by different individuals who had different objects in view, some desiring a very early crop, some wishing to select species which resist the access of profitless weeds, and others to cultivate those varieties which exhaust the soil the least. Each of these mixtures may be best adapted to the specific object of the farmer who makes it, and, if composed of a sufficient number of species, may be good, and truly economical.

The practice with many farmers has already been alluded to as consisting usually of one bushel or twelve pounds of redtop, a half a bushel or twenty-two pounds of Timothy, and from four to six or eight pounds of clover. The practice of many good farmers varies but little from this mixture.

For a permanent pasture mixture, it is highly important to bear in mind that such species should be selected as blossom at different periods, in order to secure, as far as possible, a luxuriant growth through the season; and some grasses may be used which are valuable mainly for their early growth, with less regard to their nutritive value than in mixtures for field culture.

For such a mixture, we might select the following as an example:

For Permanent Pastures.

Meadow Foxtail,	flowering	in May and June,	2 pounds.
Orchard Grass,	"	in " " "	6 "
Sweet-scented Vernal,	"	in April and May,	1 "
Meadow Fescue,	"	in May and June,	2 "
Redtop,	"	in June and July,	2 "
Kentucky Blue Grass,	"	in May and June,	4 "
Italian Rye Grass,	"	in June,	4 "
Perennial Rye Grass,	"	in "	6 "
Timothy,	"	in " and July,	3 "
Rough-stalked Meadow,	"	in " " "	2 "
Perennial Clover,	"	in "	3 "
White Clover,	"	from May to Sept.,	5 "
			40 pounds.

This mixture would give the enormous number of over 54,000,000 seeds! In an acre there are 6,272,640 inches, so that the mixture would give about eight seeds to the square inch. We see, from the preceding table, that in an old, close sward there were but about 1000 plants to the square foot, or, on an average, about seven plants to the square inch.

This is, therefore, a very large and liberal seeding, and leaves a large margin for worthless seeds, for imperfect sowing, and for destruction of plants by insects and frost.

The weight of the seeds of each of the species of the above mixture, together with the period of blossoming of each, will furnish a sufficient reason for the quantity recommended, and the reader is referred to Table XIV. for further explanation.

A permanent pasture mixture, recommended by the Messrs. Lawson & Sons, very experienced seedsmen of Edinburgh, Scotland, may be worthy of study in connection with the descriptions of the various species, as given in the first chapter. It is as follows:

Second Mixture for Permanent Pasture.

	Pounds.		Pounds.
Meadow Foxtail,	2	Perennial Rye Grass,	8
Orchard Grass,	4	Timothy,	3
Hard Fescue,	2	Wood Meadow Grass,	2
Tall Fescue,	2	Rough-stalked Meadow Grass,	2
Meadow Fescue,	2	Yellow Oat Grass,	1
Redtop,	2	Perennial Clover,	2
June Grass,	2	White Clover,	5
Italian Rye Grass,	6		45

Here we have a considerable number of species, and, according to the table on a preceding page, over forty-five million five hundred thousand seeds. Thus, though we use less than half as many seeds as our farmers generally do, we still allow more than seven seeds to the square inch, or over one thousand seeds to the square foot, a number larger than the number of plants found in the rich and closely-woven sward of an old pasture, as seen in Table XI. These, it will be seen, even if we make a large allowance for bad seeds, will produce as many plants as will grow well, while we still have by far the largest number of stalks of redtop from no less than three million seeds, though the weight of the redtop-seed is but two pounds. This mixture is designed for one acre sown without grain in the fall in northern latitudes, or in the spring in soils where spring sowing is found to do best. If any modification were proposed in the above mixture, it would be to reduce the quantity of the rye grasses, or to leave out the Italian rye grass entirely.

A mixture like the above would answer very well, and is less expensive than the following, though it is probable that the greater original outlay for the seeds recommended in the following table will be more than returned in the additional yield.

Third Mixture for Permanent Pasture.

	Pounds.		Pounds.
Meadow Foxtail,	2	Timothy,	3
Orchard Grass,	6	Wood Meadow Grass,	2
Hard Fescue,	1	Rough-stalked Meadow Grass,	2
Tall Fescue,	1	Yellow Oat Grass,	2
Meadow Fescue,	2	Tall Oat Grass,	3
Redtop,	3	Perennial Clover,	2
June Grass,	4	White Clover,	5
Italian Rye Grass,	3		
Perennial Rye Grass,	4		45

If the cultivator desires to produce a close, matted sward as soon as possible, no broad-leaved clover should be used, and the above mixture will be quite sufficient without the perennial clover.

Though the above mixtures contain so many species, it will be seen that the actual number of seeds sown is far less than is customarily used ; and for any other use than permanent pasture it is greater than need be used, since the number of plants which this would give could not grow and arrive at maturity, for want of space. In pastures that are fed down, the growth does not usually reach over five or six inches, often not that ; so that a large number of seeds is required, and that of a large number of species.

It has already been said that a large number of species will insure a much denser growth than the same number of seeds of one or two species. It may also be added that the dense growth of many species will exhaust the ground less, since they live, to some extent, upon different constituents. This is an important practical point, which will in time be appreciated. Pasture feeding is, unquestionably, far cheaper, under ordinary circumstances, than stall feeding; and the complaint of exhausted and worn-out pastures in the older

states is too well founded. Some improvement in the treatment of such lands is required, and one most important line of experiment, it seems to me, will be found in the use of a much larger number of species of the grasses, together with such other forage plants as have been found to add to the richness of pastures, and to their fattening qualities for stock. Professor Low recommends the following:

Fourth Mixture for Permanent Pasture.

	Pounds.		Pounds.
Meadow Foxtail,	$3\frac{3}{4}$	Perennial Rye Grass,	12
Orchard Grass,	$\frac{1}{2}$	Red Clover,	5
Timothy,	5	White Clover,	5
Rough-stalked Meadow Grass,	$\frac{3}{4}$	Black Medic,	2
Meadow Fescue,	2		36

This would give twelve million seven hundred and fifty-seven thousand seeds to the acre; a much less number than those recommended in the foregoing mixtures, but still a very liberal seeding, provided the seed is sound and good. I should prefer to add considerably to the quantity of orchard grass, somewhat to the rough-stalked meadow, and two or three pounds of June or Kentucky blue grass. A still larger number of species would be desirable; and the tall oat grass, hard fescue, and a small quantity of sweet-scented vernal, would be an improvement.

A mixture is sometimes wanted for pastures that are much shaded with trees; and in such cases those species should be selected which do well in such situations, blossom at different seasons, so as to give a succession of forage, and possess, at the same time, the requisite amount of nutritive elements. I would suggest the following as the

Sixth Mixture, for Permanent Pastures much shaded with trees.

	Pounds.		Pounds.
June Grass,	5	Meadow Foxtail,	2
Orchard Grass,	6	Wood Meadow Grass,	4
Sweet-scented Vernal,	3	Rough-stalked Meadow,	6
Hard Fescue,	2	Red Clover,	3
Tall Fescue,	1	White Clover,	5
Timothy,	3		40

If the object be to make a permanent lawn, as is frequently desirable around or in sight of the farm-house, something like the following mixture will generally be found to give satisfactory results:

Permanent Lawn Grasses in Mixture.

	Pounds.		Pounds.
Meadow Foxtail,	2	Timothy,	3
Sweet-scented Vernal Grass,	1	June Grass,	4
Redtop,	2	Rough-stalked Meadow Grass,	2
Hard Fescue,	3	Yellow Oat Grass,	1
Sheep's Fescue,	1	Perennial Clover,	2
Meadow Fescue,	4	Red Clover,	2
Red Fescue,	2	White Clover,	6
Italian Rye Grass,	3		44
Perennial Rye Grass,	6		

This mixture will resist the effects of our severe droughts better than those commonly used for lawns. If anything is omitted from it, the red and perennial clovers, the yellow oat grass, and a part of the rye grass, could best be spared.

Red clover, like other coarse and large-leaved plants, rather mars the beauty of fine lawns; though, as it disappears mostly after the second year, it may be of service in protecting the finer grasses. Lawns kept frequently mown are of most use as furnishing food for

calves and sheep, and are less adapted to supply the wants of larger animals.

Another mixture for lawns and pleasure-grounds, which are to be often mown, or kept short, is recommended by Parnell, as follows:

Second Mixture, for Permanent Lawns to be frequently Mown.

	Pounds.		Pounds.
Crested Dog's-tail,	11	Rough-stalked Meadow,	2
Yellow Oat Grass,	8	Redtop,	4
Hard Fescue,	5	Whitetop,	4
Wood Meadow,	4		40
June Grass,	2		

Lawns furnished with suitable grasses become much finer and more velvety, from frequent mowing, than they otherwise would be. The Lawson's mixture, for lawns frequently mown, consists mainly of the same species, but in different proportions. It is as follows:

Third Mixture, for Fine Lawns frequently Mown.

	Pounds.		Pounds.
Crested Dog's-tail,	10	Rough-stalked Meadow,	1
Hard Fescue,	4	Yellow Oat Grass,	1
Slender Fescue,	2	June Grass,	8
Perennial Rye Grass,	10	White Clover,	8
Wood Meadow Grass,	2		46

A mixture for permanent lawn pastures, or pastures lying in the vicinity of dwellings or public highways, where the owner has some regard to fineness and beauty of herbage, should, I think, be composed of a still larger number of species.

The following is suggested as most likely to secure the end desired:

Permanent Lawn Pastures.

	Pounds.		Pounds.
Meadow Foxtail,	3	Redtop,	3
Sweet-scented Vernal,	2	June Grass,	4
Orchard Grass,	3	Rough-stalked Meadow,	3
Hard Fescue,	2	Yellow Oat Grass,	1
Sheep's Fescue,	2	Red Clover,	2
Meadow Fescue,	2	Perennial Red Clover,	2
Italian Rye Grass,	3	White Clover,	4
Perennial Rye Grass,	4		
Timothy,	3		43

In all such mixtures, the early spring and the late autumn growth, as well as the general luxuriance of the summer herbage, are to be regarded. Grasses, therefore, which are characterized by their early and late growth, become of great value and importance in the mixture, even though their nutritive qualities are slight, and though they may be comparatively valueless as field grasses to be mown for hay.

If a larger number of species can be procured without too great expense, I would suggest the importance of experimenting with a still larger number of species, and smaller quantities of each; such, for instance as the following:

	Pounds.		Pounds.
Tall Oat Grass,	1¼	Sweet-scented Vernal,	1
Tall Fescue,	1¼	Timothy,	½
Meadow Fescue,	1¼	June Grass,	1
Meadow Foxtail,	1	Redtop,	½
Orchard Grass,	2	Tufted Hair Grass,	¼
Hard Fescue,	1	Red Clover,	5
Sheep's Fescue,	½	White Clover,	3
Quaking Grass,	⅓		
Comb Grass,	½		20⅓

If the farmer wishes to seed down for only a year or two, and then to break up again, regard should be had

to the habit of growth and the kind of root the grass has. Some species require three or four, and in some cases six years, to become firmly rooted and fixed in the soil; and they would, of course, be unsuited to alternate husbandry. Among them may be named the meadow foxtail and the June grass, and others of a similar character will suggest themselves in studying Chapter I.

Again, some grasses have but a comparatively slight hold upon the soil, possessing few and bulbous roots, which, when the soil is turned up, add but little to the richness of the mould; while others strike deep roots, branching in every direction, and fill the soil with a vast amount of vegetable matter, and add to its richness in decaying by the organic and inorganic matter which they leave in it.

This explains why clover is só valuable in alternate husbandry, and how it enriches the soil, by mellowing it in striking its long and deep roots into the subsoil, by sheltering it from the scorching rays of the sun, by drawing much of its nourishment and organic matter from the atmosphere, and corporifying it, as it were, so that whether it is turned under, if it is ploughed in green, or its stubble broken up to give place to other crops in the rotation, it leaves a large amount of valuable matter to decay in the soil. The importance of producing a large vegetable mass for the purpose of ploughing in green as manure has already been alluded to in another connection, and such grasses and other plants suggested as will produce the greatest luxuriance of growth, and add most to the vegetable mould in the surface soil. The point is one of vast practical importance, and the practicability of a complete system of green manuring ought to be tested by the most careful experiments.

The following is the Lawson's mixture for grasses in the rotation:

Mixture for Mowing in the Rotation.

	For one year's hay.	For one year's hay, and one year's pasture.	For one year's hay, and two years' pasture.
Redtop,	3	3	3
Italian Rye Grass,	6	6	6
Perennial Rye Grass,	3	3	3
Orchard Grass,	4	6	6
Timothy,	11	9	9
Red Clover,	8	4	2
Perennial Clover,	—	2	4
White Clover,	2	4	4
	37	37	37

As this mixture was designed for use in Scotland, it may be proper to remark that, though the latitude of Edinburgh is 55° 57′, while that of Boston is but 42° 21′, yet the mean annual temperature of the former is 47°.1 Fahr., that of the latter 48°.9, showing a very slight difference. But our summers are hotter, and we are annually liable to the most severe and parching droughts, such as are not often felt in the moist climate in Scotland.

Besides, the Italian rye grass is naturalized there, and gives enormous crops under the rich cultivation of the Lothians and the application of liquid manures. It has not been proved sufficiently capable of withstanding our droughts to give it so much prominence in the mixture, though, as already suggested, it is worthy of more careful trial than it has yet received in this country. I would suggest the following as an improvement for our purposes:

Mixture for Mowing in the Rotation.

	For one year's hay.	For one year's hay, and one year's pasture.	For one year's hay, and two years' pasture.
Redtop,	2	2	3
Italian Rye Grass,	3	4	6
Perennial Rye Grass,	3	3	3
Orchard Grass,	6	8	8
Timothy,	11	9	4
Rough-stalked Meadow,	—	2	2
Meadow Fescue,	2	3	4
Meadow Foxtail,	—	2	3
Red Clover,	8	4	2
Perennial Clover,	—	2	4
White Clover,	2	4	4
	37	42	43

A mixture has already been given for pastures in orchards and shaded places, but it frequently happens, especially in New England farming, that the mowing lands are studded with fruit-trees, and a mixture is often wanted adapted to such places. The following will be found to do well:

Mixture for Hay in Orchards and Shaded Places.

	Pounds.
Orchard Grass,	6
Hard Fescue,	2
Tall Fescue,	2
Italian Rye Grass,	3
Perennial Rye Grass,	3
Timothy,	6
Redtop,	3
Wood Meadow Grass,	4
Rough-stalked Meadow Grass,	2
June Grass,	4
Perennial Red Clover,	3
White Clover,	4
	42

The above mixture will give a great many more seeds to the acre than could be expected to grow and come to maturity in shaded places. A large allowance

is made for bad seed; but if the purchaser is confident the seed is good, from a careful trial as recommended on a previous page, two pounds may be omitted from the Timothy, one from the redtop, and either the Italian or the perennial rye grass may be omitted altogether.

The foregoing mixtures are designed rather for a medium, or a good, well-cultivated soil. For light, sandy soils, they should be varied by the use of such grasses and proportions as have been found to do best on such places. The following will be valuable as a

Mixture for Mowing on Light Lands.

	Pounds.		Pounds.
Orchard Grass	4	Perennial Rye Grass	6
June Grass	3	English Bent	2
Hard Fescue	3	Crested Dog's-tail	1
Tall Oat Grass	3	Perennial Red Clover	3
Meadow Soft Grass	3	Black Medic	2
Redtop	3	White Clover	4
Italian Rye Grass	4	Sainfoin	2
Red Fescue	2		
			45

In southern latitudes the mixture might perhaps be improved by the use of the gramma grasses (*Bouteloua*), or by the gama or sesame grass (*Tripsacum*), instead of the perennial rye grass. The following is suggested as a

Mixture for Reclaimed Peaty Lands.

	Pounds.		Pounds.
Fiorin	2	Reed Canary Grass	4
Redtop	2	Timothy	6
Hard Fescue	3	Rough-stalked Meadow Grass	3
Meadow Foxtail	2	Black Medic	2
Meadow Fescue	2	Red Clover	4
Fowl Meadow	4	White Clover	4
Italian Rye Grass	4		
Perennial Rye Grass	5		
			47

But, after all, it is as serious a mistake to mix early and late grasses together indiscriminately, as to confine our selection to one or two kinds. It is well settled, both practically and scientifically, that the highest nutritive value of the grasses is reached at the period of blossoming, and that, to obtain the best results and to make the most valuable hay, it ought to be cut and cured at that time. If allowed to stand beyond that stage it becomes more or less woody and innutritious, and, of course, less palatable and less digestible.

It is easy to see that if a considerable portion of the grass in a field blossoms in advance of the rest, as will be the case if early and late grasses are mixed together, all that portion will be too mature and comparatively worthless when the balance of the field comes into condition. It is the source of serious loss.

The early grasses ought to be kept by themselves, and the late ones by themselves; that is, the mixtures ought to be made so as to bring the period of blossoming of most of the plants at the same time. There is a further and great economy in this, in that it spreads the work over a longer season. It avoids the hurry otherwise incident to this busy time. The haying can begin on the early grasses by the middle of June, or even earlier, while with the late grasses it can safely be delayed till the first of July. To contribute something to promote this great improvement, we suggest the following: —

Early Grass Mixture. (For One Acre.)

Orchard grass	6 lbs. = ½ bushel.
Tall meadow oat grass	6 lbs. = 1 bushel, nearly.
Perennial rye grass	6 lbs. = ⅓ bushel.
June (or Kentucky blue) grass	4 lbs. = ⅓ bushel.
Meadow fescue grass	7 lbs. = ½ bushel.
Red clover	5 lbs.

Alsike clover	5 lbs.
Perennial clover	5 lbs.

This mixture is designed for mowing-lots and for hay. The grasses in this mixture are all early. Most of them, under ordinary circumstances, will blossom by the middle of June. They are all rich and nutritive, and will make the best of hay, if cut in season and properly cured.

Late Grass Mixture. (For One Acre.)

Timothy grass	11 lbs. = 1 peck.
Red-top grass	6 lbs. = ½ bushel.
Tall fescue grass	5 lbs. = ⅓ bushel.
Rough-stalked meadow grass	5 lbs. = ⅓ bushel.
Rhode Island bent grass	4 lbs. = ½ bushel.
Perennial clover	5 lbs.
Red clover	5 lbs.
Alsike clover	5 lbs.

The grasses in this mixture are all late. Timothy and red-top rarely come to blossom before July. They will not suffer if the scythe does not go into them till after the 4th. These seeds can be procured of any first-class importing seedsman, and they should be sown about the middle of August, if the ground is in suitable condition; if not, as soon thereafter as may be. If a farmer has, say, ten acres to lay down, let him sow one half of it with the early mixture and the other half with the late. If he will keep an eye on the result of the experiment for two or three years, considering the quality and quantity of the hay and the value of the aftermath, he will find that, though the mixtures may cost a trifle more than he would pay for the ordinary mixtures of timothy and red-top, his outlay for these mixtures will be worth to him more than ten times the cost.

As already seen, the general practice in New England and throughout the country is in strong contrast with the foregoing tables of mixtures; for, of the two hundred farmers heard from, all appear to raise the same species, but no two recommend the same quantities for mixture, and not one reports the use of more than two species of grass, mixed with one or sometimes two species of clover, as at all common.

As examples of the general practice as reported to me, and with which I have been familiar for many years, the following might be stated:

1. ½ bushel (6 lbs.) redtop, 1 peck (11 lbs.) Timothy, 5 lbs. red clover.
2. 1 bushel (12 lbs.) redtop, 1 peck Timothy, 8 lbs. red clover.
3. 1½ bushels (18 lbs.) redtop, 4 qts. (5½ lbs.) Timothy, 3 lbs. red clover.
4. 3 pecks (9 lbs.) redtop, 6 quarts Timothy, 6 lbs. clover.
5. 1 bushel (12 lbs.) redtop, 1 bushel (44 lbs.) Timothy, 10 to 15 lbs. clover.
6. 1 peck (3 lbs.) redtop, 1 peck (11 lbs.) Timothy, 8 lbs. clover.
7. 4 quarts (1½ lbs.) redtop, 1 peck (11 lbs.) Timothy, 2 quarts red clover, 1 pint white clover.
8. 16 quarts (6 lbs.) redtop, 12 qts. (16½ lbs.) Timothy, 6 lbs. clover.
9. 12 quarts (16½ lbs.) Timothy, 4 lbs. clover.
10. 1 bushel (12 lbs.) redtop, ½ bushel (22 lbs.) Timothy, 10 lbs. clover.
11. 1 peck redtop, 3 pecks Timothy, 6 lbs. clover.
12. 3 pecks redtop, 1 peck Timothy, 5 lbs. clover.
13. 1 bushel finetop, 1 peck Timothy, 8 lbs. clover.
14. 1 bushel redtop, 1 peck Timothy, 12 lbs. clover.
15. 16 quarts redtop, 10 quarts Timothy, 6 lbs clover.
16. 1 bushel redtop, ½ bushel Timothy, 10 lbs. clover.
17. 5 pecks redtop, ½ bushel Timothy, 4 lbs. clover.
18. 1 bushel redtop, 1 peck Timothy, 8 lbs. clover.
19. 1 peck redtop, 1 peck Timothy, 10 lbs. clover.
20. 3 pecks redtop, 8 to 10 quarts Timothy, 6 to 8 lbs. clover.

These mixtures are sufficient to show the exceeding diversity in our practice.

A little attention to the weight of the different seeds recommended in the above tables will explain why one particular quantity, which may appear small at first sight, is sufficient in some cases, as it will show a vast

difference in their weight; a given number of pounds of some species containing many more seeds, and therefore producing a far larger number of plants than an equal weight of others.

There are few points in our practice, it seems to me, where greater improvements could be made than in the selection and mixture of our grass-seeds. If the money which is now literally thrown away, by over-seeding with one or two species, were expended in procuring other species and improving our mixtures, there is but little doubt that the aggregate profit on our grass crop would be much greater than it now is.

Some maintain that one or two species are sufficient, because certain grasses are "natural," as they say, to their land, and come in of themselves. This may, in some cases, be true to some extent, for such grasses will come in, in time; but we are liable to lose sight of the fact that the loss of a full yield, in the mean time, is often very serious.

But the inference which farmers draw from this fact is not a legitimate one, for they say that it proves that the grasses that come in "naturally," that is, the wild grasses, are best adapted to the soil, and will produce more largely than others in that locality. But this, if carried out to its natural consequences, would lead to the conclusion that new species of plants should never be introduced into any soil, because those best suited to it grow there "naturally," — a principle which no man will assert.

On the contrary, one great object of all intelligent farming is to improve upon nature, and to increase the natural capacities both of the soil and of the plants which grow on it; and the introduction of new species and varieties is one of the most effectual means of accomplishing this end. Particular species of plants do

not always spring up in particular places because they are peculiarly adapted to the soil, but often from mere accident. Seeds are carried by the wind, or by animals or birds, and, being dropped, produce plants on the spot where they fall. These plants again produce seeds which fall, and in their turn produce other plants. Thus a particular species of grass, or any plant, may be introduced into and fixed in a locality where it has no special adaptation to the soil there, and the most common plants or varieties of plants will be most likely to spread in this way. Hence, the mere fact that a certain species is very generally diffused in a certain district does not, by any means, prove that it is better suited to the soil of that district than any other species, nor that it will be sure to come in if omitted in a mixture of grasses designed for such a locality.

As already said, the mixture of grass-seeds in imitation of nature, for the purpose of forming good permanent fields or pastures, is of comparatively modern origin. It was, for a long time after this practice commenced, thought to require a great while to form a thick and good sward or turf, by any artificial means. The use of a large and judiciously selected number of species has been found to accomplish this object most quickly.

Though I have expressed myself with some degree of confidence on this subject, I would still refer to the importance of careful experiment. The outlay is small, when compared with the losses now sustained in over-seeding with too few species, and from small or medium crops; and the farmer can soon satisfy himself as to the profit of more attention to the mixtures of grasses.

More than sixty years ago, careful experiments were

made, in the hope of obtaining such information as would settle the question as to the best time of sowing grass-seed, and the practice of seeding down in the fall was then commenced by a few individuals. At and before that time, the practice of sowing in the spring was universal, and the same custom has very generally prevailed till within a very few years. Both the practice and the opinion of the best practical farmers in the northern and eastern states have changed to a considerable extent, and it is now commonly thought best to sow grass-seed in the fall, early in September, if possible, mixing no grain or anything else with it, though there are, and always will be, some cases where the practice of sowing in the spring with grain is convenient and judicious.

There can be no doubt that it is, in most cases, an injury to both crops to sow grain and grass-seed together. The following statement of an experienced and successful farmer will enable us to comprehend how the change was brought about, though others had tried the same experiment long before him. "More than twenty years ago, we had several dry summers, in the springs of which I had sown grass-seed with rye, barley, and sometimes wheat, and lost most of my seed by the drought. I could scrape it up, the plants being dead and dry, when small. Since that time I have universally ploughed after haying, and sowed Timothy grass and redtop."

Other farmers probably experienced the same difficulty, and came to the same conclusion. Our seasons differ greatly, it is true, but it is now well understood that we must calculate on a drought in some part of the summer, and grass will suffer more from drought than from frost. Hence the propriety of fall sowing. There are some localities, undoubtedly, where spring

sowing with grain is best, on the whole, as along the coast, where, on account of the proximity of the sea, the ground is often but slightly covered and protected with snow; yet even there some farmers say it is better to seed in August and September.

Few general rules are of universal application, and the farmer must constantly exercise sound judgment and common sense. One practical farmer, in answer to the circular, says: "I prefer August, because I think it less liable to winter-kill than summer-kill. And another greater reason is, that in fall seeding I get rid of a crop of weeds, while in spring seeding my ground is seeded with them." Another experienced farmer writes me: "I rather prefer the last week in August for seeding down land. The reason is, that we frequently have a summer drought which kills out the young grass;" and another says, "When sown alone, I prefer from the 20th of August to the 20th of September. If sown sooner, the summer droughts are apt to injure the young blades; if later, they do not have a chance to expand and arrive at that degree of maturity necessary for a good crop the ensuing season." He says, also, that if, in any case, it is found necessary to sow with grain, it should be in the spring, and not in the fall. Another farmer recommends "the latter part of August and the month of September for seeding down land to grass for mowing, unless that season should be very dry; in that case, sow so soon after a rain as may be. I do not think it advisable to sow grass-seed when the earth is very dry, as some of it may, by the moisture brought up in preparing the land, sprout, but, not having continued moisture to support it, will wither away, while some of the lighter seeds will, perhaps, swell by moisture, but fail to sprout, for a lack of nourishment, and consequently perish, while others will be blown away by the winds.

The plant from seed sown in August or September, if the season is moist, will take deep root, and be prepared to withstand the changes of winter. Grass-seed sown with grain in the spring is liable to be killed in the hot days of July and August, about the time of cutting the grain, particularly on light, sandy, or gravelly lands. Clover should be sown in the spring as soon as convenient after the frost is out of the ground, on land seeded down the preceding autumn, probably, rather than sooner in the autumn, as the winter is often too severe for the tender roots."

An experienced farmer writes as follows: "On moist land I prefer to turn over the green sward, after haying, with a Michigan plough, and seed in August, after spreading on a coat of manure, to give the grass an early start;" and another, "I consider the month of August as the best time to seed down land for mowing, with the exception of clover, and that I sow early in spring." "I think August or the early part of September is the best time to seed down grass land," says another, "as in the fall of the year it will get root, and not be burned up by the sun, as it would be in spring." Another says, "I sow from the middle of August to the middle of September. If sown in spring with oats or other grain, the young grass is liable to be summer-killed, either choked by the ranker growth of the grain, or scorched by the hot sun when the grain is taken off. If sown in spring without grain, there is one season lost."

A farmer on the Connecticut River states that "if the season is not too dry, August is a good month to seed for mowing. I have had very good success in seeding with turnips, or grass-seed alone, in August or September, to mow the next year; but the usual practice here is to seed with wheat or rye, in September or

October. Some seed in spring with oats, but generally it does not do well. Clover is more often sown in the spring, because it winter-kills." Another says, "There is a difference of opinion among farmers in this region on this subject; some prefer to sow the grass-seed with the spring grain in May, while others prefer to sow in August. The latter, no doubt, is the best practice, if the ground is sufficiently moist."

But, on the other hand, an experienced practical farmer on the sea-coast says, "I prefer seeding down land designed for mowing in April, for the reason that if sown in March the ground becomes so compact, from the effects of heavy rains, that the seed does not come up well, and if sown in August or September, the grass does not attain that degree of maturity to enable it to withstand the frequent freezing and thawing of the succeeding winter. We usually have but little snow to protect the young grass on this island. The objection to sowing grass-seed after English harvest will not probably apply to those places where the winters are less changeable."

Another says: "I have sown grass-seed in the months of March, April, May, August, September, and October. On a rich, compact, retentive soil, seed has done well sown in April or May, but I prefer to seed my land of any description in August, or on a light snow in March. My reason is, that when I have seeded my ground in the spring, I have sown rye or oats with the grass-seed generally; if not, a crop of weeds would come up and usurp the place of the grasses and choke them out, and a hot and dry July and August would exterminate what escaped the oats and weeds."

Thus, the opinions and practice of farmers are divided on this question, each one being influenced in part by the character of his land and his crops. But it will be

found that no season is without its exposure to loss; for, if we sow in autumn and have an open and severe winter, with frequent changes from comparatively warm and thawing weather to excessive cold, the young grass will be likely to suffer; while, if we sow in spring with some kind of grain, as oats, barley, or rye, and have a drought in spring or summer, as we generally do, the grass may be injured, and may be entirely killed. No invariable rule for all soils and seasons can be given. But the weight of authority seems to fix upon early autumn as the best season to sow grass-seed, sowing it alone, without a grain crop; and the losses from proper seeding down at that season are probably considerably less, in an average of years, than those which arise from spring sowing with grain.

This does not, perhaps, apply to very strong clayey soils, which retain a large amount of moisture. On such soils the frost is very liable to "heave" the roots, and unless they are rolled very early in spring, which, on such lands, is not usually practicable, the young plants are entirely destroyed. Such lands, it is well known, require thorough drainage. They are difficult to till profitably without it, and, when once thoroughly drained, the same rule, as to the time of sowing, would apply to them, as to medium soils.

No rule in regard to the time of seeding down land, which should be found to work best in one latitude, would necessarily apply in a different climate, and under different circumstances.

CHAPTER IX.

TIME AND MODE OF CUTTING GRASS FOR HAY.

HAVING carefully selected and judiciously mixed and sown his grass-seed at a proper season, on land properly prepared, the farmer may confidently hope to have an abundant crop of grass the following year, when there naturally arises one of the most important questions in the economy of the farm, and that is when to cut grass to make into hay, or at what stage of its growth it is most valuable for that purpose. This is a point on which even experienced farmers differ, but the weight of authority will be found strongly for cutting at the time of flowering.

Most practical farmers, in answer to this question, say that hay is sweeter, and possesses more nutriment, when cut in full blossom, than at any other stage. One of the most intelligent farmers in the country says: "I prefer to cut grass when in blossom, because it will make more milk and more fat, and cattle prefer it to that standing later. It keeps them healthy. I have no doubt hay of the same bulk weighs more if it stands in the field till the seed forms, and for this reason some who sell most of their hay let it stand." "When designed for milch cows, store, or fattening animals," says another, "I prefer to cut in the blossom, because it makes more milk, more growth, and more beef. For working cattle and horses I cut about six days after the pollen has fallen, because it does not scour or loosen

the animal so much as when cut in the blossom." Another says: "Next to sweet, fresh grass, we think that rowen will make cows, working cattle, or horses, thrive better than any other feed, unless in the case of cattle hard at work. We conclude, therefore, that all hay is best cut early. Coarse hay will keep stock tolerably well, cut early, which, if allowed to mature, would not be eaten at all."

The testimony of another practical farmer on this point is as follows: "We cut after the blossoms begin to fall, and before they have all fallen. It has more substance and weight cut at that time than if cut sooner, more sweetness and juice than if cut later." Another farmer says: "Our rule is to cut hay in the blossom, as it is then in the best state for feeding,—less woody and much sweeter than later, and leaves the roots in better state for a second, or another annual crop." Another very intelligent practical farmer says: "We cut in blossom, because it is then most palatable to stock. If allowed to stand much longer, there is a draft upon the soil for the growth of the seed, which is not repaid by the additional value of the hay, if, indeed, it is increased in value at all. My opinion, derived from my own experience, is, that the grasses will sooner die out if allowed to stand later." A farmer who prefers to cut all other grasses when in blossom says, "It will not do to cut blue joint or fowl meadow till some of the seeds fall, as it will soon run them out." An intelligent farmer of Massachusetts says, "When English grass is in full blossom it has all the good qualities it can have. From that time I think it loses in value in proportion to the time which it stands. Swale hay should be cut rather green. If fully ripe, it is hard and dry." Another says: "We cut about the time the blossom falls. The grass is then at its full growth. If

it stands much longer, the leaves begin to die at the bottom, and the grass grows tough and hard; and I think the longer it stands, the less it will weigh when dried. If it is cut much earlier, it will shrink and dry up, and does not seem to have so much nutriment in it; and I have noticed cattle will eat more in bulk than when cut at the right time." And still another: "The time of cutting depends very much upon the use you wish to make of it. If for working oxen and horses, I would let it stand till a little out of the blossom; but, if to feed out to new milch cows in the winter, I would prefer to cut it very green. It is then worth, for the making of milk in the winter, almost double that cut later." One other extract will suffice. "I cut my red clover before the heads begin to turn brown. When the clover is quite heavy I cut it when only one half of the heads have blossomed, because then cattle will eat all the stems. Clover is injured more by half, when it stands long after blossoming, than any other kind. I find my clover hay in the barn much heavier when cut quite early."

These extracts, taken at random from a large number of letters from practical farmers, in different parts of the country, indicate very clearly the prevailing practice. The replies from about one hundred and fifty different individuals show that farmers prefer to cut the principal grasses, Timothy and redtop, when in full blossom; red clover, when about half the heads are in blossom; and swale grass, before it is ripe, and generally before blossoming, if possible, so as to prevent it from becoming hard and wiry.

This practice is unquestionably founded on a correct principle, the object of the farmer being to secure his hay so as to make it most like grass in its perfect condition. From principles stated in another place, it has

been seen that the nutritive substances of grass are those which are, for the most part, soluble in water, such as sugar, gluten, and other compounds. Now, it is evident that, if this is so, the grass should be cut at the time when it contains the largest amount of these principles. In its early stages of growth it contains a very large percentage of water. From its earliest growth the sugar and other soluble substances gradually increase, till they reach their maximum percentage in the blossom, or when the seed is fully formed in the cell. From this period the saccharine matter constantly diminishes, and the woody fibre, perfectly insoluble in water, and innutritious, increases till after the seeds have matured, when the plant begins to decay. Of course, if the plant is not cut in the flower, a great part of the nutriment of its stems and leaves is wasted.

There are, perhaps, exceptions to this in the natural grasses, as already seen in considering their nutritive qualities, and in the analyses at different periods of their growth. Thus, in case of the orchard grass, Sinclair found the nutritive matter at the time the seed was ripe, and at the time of flowering, as seven to five; and the stems of Timothy were found to contain more nutritive matter when the plant was ripe than at the time of flowering, though it was found that the loss of aftermath, which would have formed had the plant been cut in blossom, more than balanced the gain of nutritive matter in the ripening of the seed. Most of the grasses, too, make a greater quantity of hay when cut at the time of blossoming, though the crested dog's-tail has been found to be an exception to this rule. Fowl meadow, also, contains an equal quantity of produce at the time of ripening the seed and at the time of blossoming, and the nutritive matter at both periods is about the same. It will be found in practice generally

to be better to be a little too early than too late; for the gain is in two directions,—in a greater nutritive substance at the time of blossoming, which is certainly a sufficient consideration of itself, and in the larger growth of the lattermath, which will spring up on good land and in a good season.

We might also reason from analogy in other plants; for it is a well-known fact that the best vegetable extracts for medicinal and other purposes are procured from plants when in blossom. Prof. Kirtland, of Ohio, states that an observing practical farmer of his neighborhood, after many careful observations on the growth of Timothy, has arrived at these propositions:

1. That Timothy grass is a perennial plant, which renews itself by an annual formation of "bulbs," or perhaps, more correctly speaking, tubers, in which the vitality of the plant is concentrated during the winter. These form in whatever locality the plant is selected, without reference to dryness or moisture. From these proceed the stalks which support the leaves and head, and from the same source spread out the numerous fibres forming the true roots.

2. To insure a perfect development of tubers, a certain amount of nutrition must be assimilated in the leaves, and returned to the base of the plant, through the stalk.

3. As soon as the process of nutrition is completed, it becomes manifest by the appearance of a state of desiccation, or dryness, always commencing at a point directly above either the first or second joint of the stem, near the crown of the tuber. From this point the desiccation gradually progresses upwards, and the last portion of the stalk that yields up its freshness is that adjoining the head. Coïncident with the beginning of this process is the full development of the seeds, and

with its progress they mature. Its earliest appearance is evidence that both the tubers and seeds have received

Fig. 158.

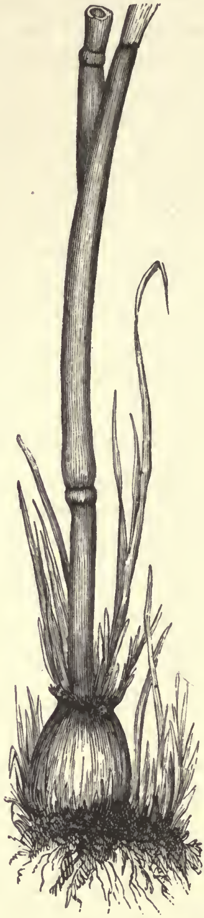

Fig. 159.

Fig. 160.

their requisite supplies of nutrition, and that neither the stalk nor the leaves are longer necessary to aid them in

completing their maturity. A similar process occurs in the union just above the crown of the bulb, indicating the maturity of that organ. Fig. 159 represents the bulb fully developed and mature, from which the stalk was cut, after the nutritive process was completed, above the point where drying or desiccation had begun.

4. If the stalk be cut from the tubers before this evidence of maturity has appeared, the necessary supplies of nutrition will be arrested, their proper growth will cease, and an effort will be made to repair the injury by sending out small, lateral tubers, from which weak and unhealthy stalks will proceed, at the expense of the original tubers. This is seen in Fig. 158. All will ultimately perish, either by the droughts of autumn or the cold of winter.

5. The tubers, together with one or two of the lower joints of the stalk, remain fresh and green during the winter, if left to take their natural course; but if, by any means, this green portion be severed, at any season of the year, the result will be the death of the plant, when it will appear as in Fig. 160.

From these five propositions the following conclusions are drawn:

1. That Timothy grass cannot, under any circumstances, be adapted for pasture, as the close nipping of horses and sheep is fatal to the tubers, which are also extensively destroyed by swine, if allowed to run in the pasture.

2. That the proper time for mowing Timothy is at any time after the process of desiccation has commenced on the stalk, as noted in the third proposition. It is not very essential whether it is performed a week earlier or later, provided it be postponed till that evidence of maturity has become manifest.

3. All attempts at close shaving the sward should be avoided while using the scythe, and in gauging mowing machines care should be taken to run them so high that they will not cut the Timothy below the second joint above the tuber.

I have frequently pulled up the bulbous roots of Timothy from the stubble, from which a heavy crop had been cut with the scythe, while in flower, for the purpose of studying the changes which were taking place in these tubers, and have found them very similar to those represented in Figs. 159 and 160, not only on moist, damp soils, but also on soils comparatively dry. Any farmer can satisfy himself of the correctness of these representations by a little observation in his own fields; and, as the point is of practical importance, it is worthy of careful attention.

The facts above alluded to have fallen under the observation of a practical farmer, who writes me as follows: "The proper time to cut Timothy is after the seed is formed, and is full in the milk. It will then give about twenty per cent. more weight than when it is just coming into the blossom, and the cattle will eat twenty per cent. less and keep on their flesh. And I prefer also to cut it at that stage of its growth, on account of the roots being better able to withstand the drought. It should be cut four inches from the ground, as most of the Timothy is killed by mowing close and early, before it has come to maturity. I have kept Timothy thick and strong in the land six years by following this method. I have noticed that most of it has died out by once or twice close and early mowing, before the grass has come to maturity. If it is dry weather, it is sure to die when so cut. I lost a whole field of it by mowing too close and early, and I consider the four inches at the bottom of coarse Timothy of little value."

If the seed is allowed to ripen, it exhausts the soil far more than if cut in the blossom.

The old methods of cutting grass for hay are familiar to every practical farmer. The hay crop of the country must be gathered at a season when labor is to be obtained with difficulty, and at even higher than the usual high wages, and when the weather is often fickle and precarious, generally oppressively hot, making the task doubly irksome and wearing. But, besides this, many acres of grass on our ordinary farms ripen at

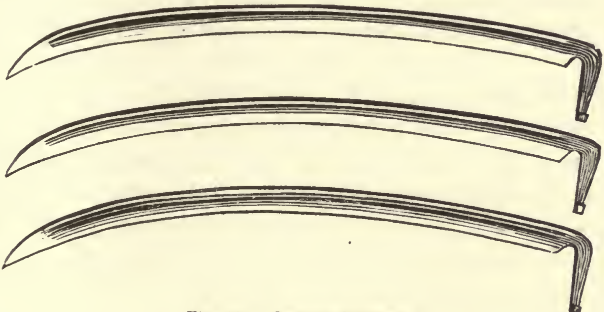

Fig. 161. Common Scythes.

about the same time, which, if allowed to stand too long, will decrease in quantity and value of hay which might otherwise have been made from it. This last consideration I regard as one of the strongest reasons for availing ourselves of the use of the mowing machine, by which it can be secured and saved most quickly, easily, and cheaply.

Mowing with the common scythe (Fig. 161) is, at best, one of the severest labors on the farm, notwithstanding the efforts of poets and other writers to make people believe it is all fun. It calls into play nearly every voluntary muscle in the body, requiring not only the more frequent and regular movements of these muscles, but, on account of the twisting motion of the

body, an unusually great exertion of muscular power. Nor does it require any small amount of skill to become a good mower, since it is proverbial that, unless the boy becomes accustomed to the scythe, and learns while young, he can never become a skilful mower.

That the ingenuity of man should have been turned into this direction, therefore, and studied to shorten and lighten this severe operation, is not at all strange. That it should not have been done before, should, perhaps, rather excite our surprise. The reaper has been known and used on a limited scale for half a century; and, as the process of mowing by machinery is not wholly unlike that of reaping, the one would seem to have been naturally suggested by the other.

The first mowing machine which met with any success in this country is believed to have been that of William Manning, of New Jersey, patented in 1831, and which met with a limited success more than twenty years ago. The machine was furnished with the serrated or saw-tooth knife, having a vibratory motion.

In 1834 appeared the Ambler patent, simple in its construction, with a cutter-bar of wrought iron, and a single smooth-edged knife, operated by means of a crank, which gave it the vibratory motion. It was used to considerable extent in 1835 and 1836.

Another machine was used to some extent in 1835, by which the cutting was performed by circular knives, fastened on the periphery of a horizontal wheel, five feet in diameter. The wheel was suspended on a perpendicular iron shaft, which hung on a lever, by means of which the driver could elevate or lower the knives, at will. The motion was given by gearing connected with the wheels on which the machine rested. It was operated by two horses, and was capable of mowing ten acres a day.

Wilson's machine was very successful in experiments made in 1837. It could be operated by one horse walking behind the machine. The grass was so left as not to need spreading.

Another horse-mowing machine, that of Huzza, of Cincinnati, met with a limited success as early as 1836.

But it was not till a very recent date that the machine was constructed in a manner to give confident hope of its ultimate and perfect success.

The experiments made with mowing machines have at least demonstrated, beyond a doubt, that grass can be cut quickly and economically by horse or ox power, and the objections which are most commonly made to them are such as can easily be obviated by a more perfect manufacture, and by more skill on the part of the operator. It is, indeed, a mortifying fact, that they have been, in many cases, very imperfectly made; and the fact that many now in use have so often got out of order has thrown doubts upon their utility as a whole, and retarded their introduction very greatly. But this difficulty does not arise from any defect in the principle of the machine, and many failures, no doubt, are to be ascribed mainly to the impatience of the operator.

It is not unfrequently the case that a man purchases a new machine or borrows one, and, on starting off without sufficient care, finds himself brought to a stand, with, perhaps, a broken machine; and, instead of seeking the cause, and repairing the damage, and starting anew, throws it aside as entirely worthless, and condemns the implement at once. Some of our most useful and now familiar farm implements have been repeatedly thrown aside, at first, by the fault mainly of the operator. A machine ought not to be condemned till after a complete and full trial. But enough of these machines have succeeded, to the perfect satisfaction of

the community, to show that, whatever defects some of them may have, they may be made to accomplish the work for which they were intended.

The manufacturer is not alone to blame, as a general thing, for the defects of an implement to be used on the farm. The farmer too often prefers a machine which is least expensive, and no matter how well it is made, he will insist upon having it at the lowest possible price at which it can be afforded. Manufacturers are therefore compelled to slight the work in order to meet the wants of the people, and cheaply-made articles alone can be sold cheap enough to suit the wishes of the buyer. In this way both the manufacturer and the farmer suffer. It is poor economy, as a general rule, to buy cheap articles.

As to the comparative economy of the use of the machine and hand labor on small farms, it seems to me the experiments of the past season throughout the country have fully decided the question in favor of the former. On this point, however, the opinions of practical men will be found to differ, to some extent, though the weight of the testimony of those who have had any actual experience with the machine will be found to be strongly in its favor. And this is especially the case of those who have been fortunate in obtaining a machine properly constructed and put together.

In answer to the circular sent out to obtain the opinions of practical farmers as to the result of their experience with the use of the machine, one writes me, saying: "As to the economy of its use in our vicinity, we have no hesitation in saying that one-half of the expense is saved in using the machine to cut and spread grass, when compared with the common scythe, to say nothing of having it done when the weather is good and the grass in its proper state, whether in blossom

or gone to seed, as the owner prefers. The horses that we have used from the first weigh from ten to eleven hundred each. We believe horses of the above weight the best adapted to all farm work, and, of course, best for mowing, carting, and ploughing. Were the team for mowing and nothing else, we should have no objection to their weighing more than the above, provided they were smart and active; but a slow, logy team is not the thing; for it needs prompt action to start off in good shape and to work well.

"We consider the draught not heavier than that of the common plough. Were it used at the same time of the year, our opinion is that the team would chafe and sweat quite as much. A man on his own farm would have no occasion to work his team so as to injure it in the least, for the reason that he could mow more in the first half of the day than he could secure in the afternoon of the same or the next day, with the same team. We have done our mowing, the past season, with one and the same pair of horses, working them from three to seven hours per day. The usual practice is to mow in the morning two or three hours or more, as the case may be, and use the same team in the afternoon to draw the hay to the barn, which is from one to two miles distant. The speed required to work a machine to advantage is about the same as that for a plough on stubble-land, or from two and one-half to three miles per hour. There is no objection to quicker speed, however, in making good work."

In a case within my knowledge, a machine with a cutter-bar five feet in length, and with horses weighing in harness 1,968 pounds, driven at a moderate speed, only equal to 20 rods a minute, or $3\frac{3}{4}$ miles an hour, a half-acre, 20 rods by 4, with a burden of 2,400 pounds of hay to the acre, was cut in fourteen swaths, an average of $4\frac{71}{100}$ feet, in eighteen minutes, including the

turnings. This would be $2\frac{91}{100}$ miles the hour, including the turnings. At this rate, 1,210 square feet of grass were cut in a minute. At the same time a good mower cut a swath 168 feet long and 7 feet wide, making 1,176 square feet, in $3\frac{1}{2}$ minutes; or, at the rate of 336 square feet in a minute, allowing no time for rest or to sharpen the scythe. Now, allowing the machine no time for rest or turning, it cut a swath $4\frac{71}{100}$ feet wide and 20 rods long, equal to $1,554\frac{3}{10}$ square feet in a minute, or $4\frac{65}{100}$ times more than a good mower with a scythe in the same time. It is natural to suppose that a man mowing with such a competition and a large number of spectators would exert himself to his utmost, and that he could not mow half a day at the same rate; and it is certain that he was far better as a mower than the average of farm laborers, while at the same time it is evident, from the above-named speed, that the team, with the machine, could work pretty steadily.

It is, therefore, fair to state the comparative quantity cut by the machine, in this experiment, as five times greater than that cut by the mower. That is to say, one man, a pair of horses, and a machine, would cut as much in a half-day as five men, or a pair of horses and a machine equal to four men. Now, as to the work performed, it was admitted by all that the machine cut much the best; and, when it is considered that with the *mowers* one man is required to every five to do the spreading, we have to credit the machine with another man's labor in spreading, or a machine and horses equal to five men instead of four, or, including the driver, machine, and horses, equal to six men. This supposes, we will say, a half-day's work.

The cost of the six men for the half-day, in haying, would be at least four dollars and a half, under ordinary circumstances. The cost of a driver would, at the same

rate, be seventy-five cents for the half-day. The keep of the horses, at seventy-five cents per day, would be equal to thirty-seven and one-half cents, and, allowing for the use of the machine a dollar a day, which is, perhaps, a fair charge, we have, for the cost of machine labor, one dollar and sixty-two and one-half cents, instead of four dollars and a half, or, adding a dollar more for the interest on cost of horses, and we have two dollars and sixty-two and one-half cents to compare with four dollars and fifty cents, the cost of men.

In another instance, where a four-feet eight-inch cutter-bar was used, instead of five-feet, the horses weighing 1,820 pounds, instead of 1,968, the trial was made on a piece similar to the last, 4 rods by 20, having a burden equal to 2,700 pounds of hay to the acre; the machine made 17 swaths, averaging $3\frac{88}{100}$ feet to each, mowing the half-acre in 19 minutes, at a speed, including turnings, of $3\frac{35}{100}$ miles an hour, cutting $1,146\frac{31}{100}$ square feet of grass a minute, including the turnings. A good mower, on the same field, cut a swath 20 rods or 330 feet long and $6\frac{1}{2}$ feet wide, or 2,145 square feet, in $7\frac{1}{2}$ minutes, or 286 square feet in a minute, allowing no time for rest or sharpening the scythe. Here the machine cut $4\frac{2}{100}$ times as much as the man; or, allowing the machine no time for rest or turning, it cut $1,270\frac{4}{10}$ square feet a minute, or $4\frac{44}{100}$ times more than the man in the same time. In the first instance, $4\frac{65}{100}$ times, with the five-feet cutter-bar.

Many similar experiments, in different parts of the country, have come within my knowledge, where the results were so nearly alike as to lead to the conclusion that the above is a fair calculation for lots similarly situated.

"The gain in cutting the grass," says an experienced practical farmer, "must be apparent to all who have

land smooth enough to work a machine on; and in this connection it may be best to speak of the horse-rake with the mower, as one naturally follows the other, and

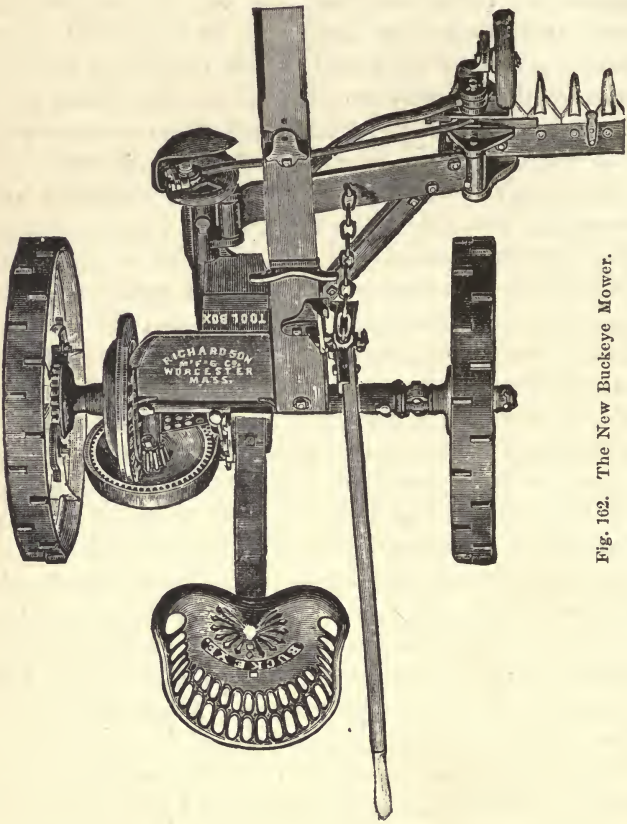

Fig. 162. The New Buckeye Mower.

is about as important in the operations of haying. Our way of getting hay when, the weather is good, is this: To cut and rake it into the windrow the first day.

The next, open and turn it, if necessary, then rake it and cart it.

"Now, one man with a machine and horses, in the forenoon, and one horse and rake three hours after dinner, can put five or six acres of grass into the windrow every day, if he chooses, which is as much as ordinary farmers in this vicinity wish to do, as our hay has to be carted from one to two miles, and that takes time. How many men will it take to do the same work? Any one can answer this to his own satisfaction; and, as labor differs in price in almost every section of the country, the actual cost would vary somewhat. But here it would take from five to ten men to do the same work, varying as the burden of grass does per acre; for in lodged grass ten would hardly do.

"Then the advantage of having it done in good weather, and cutting the grass when he chooses, whether in blossom or after it is fully ripe, I think can be safely put down at ten per cent., and some call it as high as twenty per cent."

From what has already been said, and from the testimony of many practical farmers, it appears that the estimate which has been made, requiring five men to do the work of one man, machine, and team, or six men, including the spreading, is a very reasonable one, since, in the cases stated, no allowance is made for the want of endurance of the men at the rate at which they worked in the experiments named.

Other considerations give further credit to the machine, since the grass was mown better than the average of good mowers, while it is easy to see that it was spread better by the machine, thus making a saving in the quality of the hay cured.

The cost of a man, machine, and horses, for a day, according to what has been said, would be not far from

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four dollars and fifty cents, while the cost of their equivalent in men would be not far from nine dollars. This calculation is based on the cost of keeping the team and price of labor on small farms, and it seems to show the economy of machine labor there. How much more valuable may it not be on the large farms of the Middle and Western States?

But, with regard to the economy of the use of the machine, it seems to me that, even if the cost per acre were the same as by hand labor, — and all unite in putting it less, — we should, nevertheless, consider it a great and clear gain to have it in our power to substitute machinery which will cut grass well and rapidly at a time when labor is very difficult to obtain, without paying an exorbitant price for it. And even supposing the money cost of hand and horse labor to be the same, there is still this further consideration in favor of the machine, that, as a general rule, every mechanical operation which can be effected at all by machinery will be performed more accurately, more uniformly, and therefore more economically, than by hand labor.

Among the important lessons taught us by the use of the machine is, that the fewer division fences on the farm the better. It has been the custom, from time immemorial, in some parts of the country, to dispose of the stones turned out by the plough in ugly-looking stone walls, which mar the beauty of the farm, and occupy much land which is now thought to be worth something for the purposes of cultivation. The idea was to have a frequent change of pasturage for cattle, rather than to allow them to range over a wide extent, without much confinement. This minute subdivision of farms is a great impediment to the economical use of machinery, and even of animal power to any great

extent; and many an old wall which was built fifty or a hundred years ago, at great labor and cost, perhaps for the purpose of getting rid of a surplus of rocks that en-

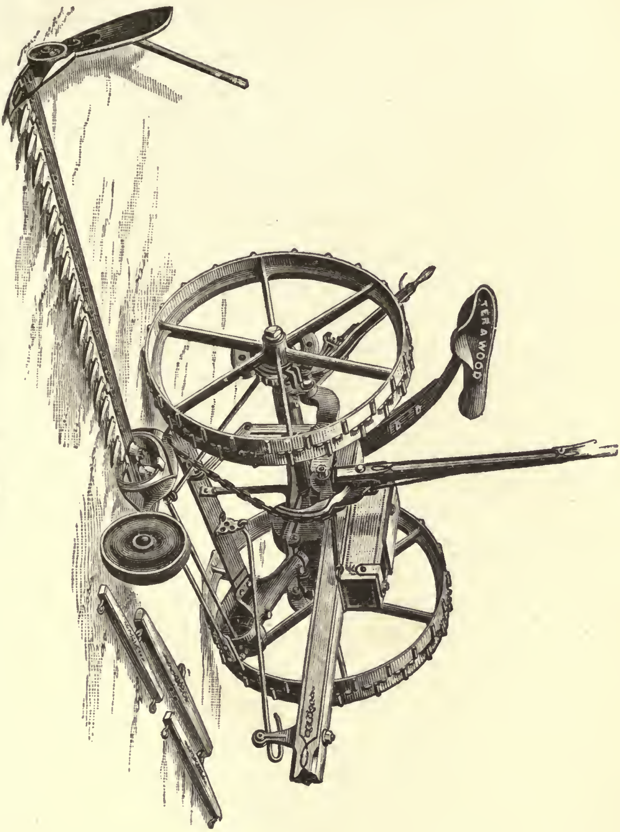

Fig. 163. The Wood Mower.

cumbered the land, and has come to occupy twice or three times the space originally allotted to it, is now being removed and buried beneath the surface or other-

wise disposed of. With small lots, the farmer loses the time of turning at every furrow in ploughing, and other operations of a similar nature, like the use of the mowing machine and the horse-rake. There is one advantage, however, of no small importance, in these division fences, and that is the protection which they afford to the field in breaking the fierce winds, in arresting leaves and dust, which settle upon and fertilize the soil.

Another important lesson taught us by the use of the machine is, that the stouter the grass is, — other things being equal, — the more easily and economically it can be mown; and hence the importance of a high and thorough cultivation of all grass lands, not simply in the clearing away of stones, stumps, or other obstructions, which the use of the machine will lead to, but in the use of more manure, and the more complete and thorough tillage with the plough, the harrow, and the roller. Many farmers have already taken the hint, and are preparing their lands with reference to some future use of a mowing machine.

But the experiments thus far made establish conclusively that the machine can be used in a far greater variety of circumstances than was at first supposed. I have seen it operate safely and advantageously on rough lands covered with stones, on hilly and broken surfaces, reclaimed bogs and salt marshes, with two horses, with one horse, and with oxen, and with fewer accidents than might reasonably have been anticipated under the circumstances of a new implement, and want of experience and skill incident to the introduction of machinery. It is, nevertheless, true that it will prove to be a great saving, in the end, to put the field in good condition, have it free from stones and all other obstructions; and some doubt whether it is economical to buy and use a machine till this state of cultivation is

attained, or at least till an approximation is made to thorough tillage.

The average time required is about forty-five minutes per acre. I have known eight acres, yielding sixteen tons of hay, to be cut in three hours and forty minutes, or at an average rate of twenty-seven minutes per acre. After making all necessary allowance for stoppages to rest the team, and occasionally to repair the machine, we may reasonably estimate the work which could be done, without over-urging, at an acre per hour.

As to the power required, all the reports concur in saying that there is less labor for the horses than in ploughing. In most cases the horses actually gained in weight while they worked with the machine. This is the testimony, not only of competitors, but also of committees of various agricultural societies. One of these committees says, "The team used may be called a fair average of farm-horses, the pair weighing about two thousand pounds. They required no urging, so far as we could observe, but performed their daily work on the machine with ease, and, could they give an opinion, your committee have no doubt they would consider mowing the most agreeable part of the harvest labor."

It is also the opinion of most who have used the machine that horses of medium size, say from nine to ten hundred pounds in weight, do their work, on the whole, with greater ease and safety than larger ones. This is especially the case on soft or wet ground.

Much observation leads to the belief that, at the rate of an acre per hour, including all ordinary stops, a good pair of horses could continue the work so as to cut, without undue exertion, from ten to twelve acres a day.

Many think it to be far more economical to use oxen than horses on small farms, and hence many farmers

prefer the former to the latter. In many cases where the mowing machine has been worked by oxen they did as well as horses, while they did not apparently suffer from the exertion, even in the hot weather of July. This fact will make it possible for many to use this implement who could not otherwise do so, and its advantages will thus be brought within the reach of thousands who cannot afford to use horses.

There are some general suggestions for beginners in the use of the mowing machine, most of which are alluded to in the letters of practical farmers already quoted, but which may be briefly summed up as follows:

1st. See that the knives are sharp, and in good order. No man would think of beginning his day's work of mowing without having first ground his scythe. A dull scythe requires too great an expenditure of physical force, and the mower works to great disadvantage. The same is true of the machine. The labor for the team is quite sufficient, even under the most favorable circumstances, without increasing it by neglect in this particular.

2d. See that every nut and bolt is perfectly tight; the wear of the machine will be less, and it will be less likely to get out of order.

3d. Keep all the bearings well oiled with pure sperm oil; some of them will need an application of it every ten or fifteen minutes.

4th. Take the field lengthwise, and keep straight forward, at a regular, steady pace, without too great haste, which would fret and worry the team. An acre per hour is fast enough ordinarily, and the team will do that without over-urging, if the driver be skilful.

Other things, of minor importance, will suggest them-

selves after a little practice. But it is especially important to have patience and perseverance, and not to give up in discouragement on account of a failure at the outset, nor even if there should be a second or a third mishap; for, if proper care was taken in selecting the machine, these difficulties show either the want of sufficient study of all its parts, or some mistake in putting it together. Many will give up, in despair, if they have met only with some one of the slight accidents to which every new implement is liable, particularly when time presses and things go wrong.

That some degree of skill is necessary for the proper use of the mowing machine, is no objection to it, since even the common scythe requires skill, and it is rare that any man who has failed to obtain that skill by practice, when young, ever becomes a good mower. If the machine were so complicated that only a mechanic could operate it, no doubt the fact that it was so would be a serious obstacle to its introduction. But this is not the case, and it is the general testimony that any farmer of ordinary capacity can very soon learn to work it successfully.

What has been said of the mowing machine applies with equal force to the reaper, into which the former may be easily converted.

Many of our grain crops, like wheat, barley, and oats, come to their maturity at nearly the same time. Some varieties of oats are very easily shaken out, and never should be allowed to become over-ripe; wheat is very liable to sprout in moist weather, and barley to become discolored, if allowed to stand too long. The work of harvesting by the old methods was necessarily protracted. Previous to the introduction of the reaper, very large quantities of our most valuable grains were annually lost, from the impossibility of harvesting

them properly and in time. It is not too much to say that the successful introduction of the reaper into our grain-fields has added many millions of dollars to the value of our annual harvest, not only by enabling us to secure the whole product of all that was before planted, but also by making it possible for the farmer to increase the area of his cultivated fields, with a certainty of being able to gather in his whole crop.

The sickle is undoubtedly as old as the days of Tubal Cain, and was almost universally used till within the memory of men still living. No one, who has had a practical experience of its use, can fail to appreciate the immense saving of slow and wearisome hand labor by the use of the reaper.

The reaper is no new thing in point of fact. It would, indeed, have been an astonishing evidence of stupidity on the part of the ancients, who relied mainly upon wheat and the other small grains, had they not, at least, tried to replace the sickle by something better. This they did. They were accustomed to use a simple reaper in France, a few years after Christ; for Pliny asserts that the inhabitants of that country fixed a series of knives into the tail-end of a cart, and this, being propelled through the grain, clipped off the ears or heads, and thus it was harvested.

In England the importance of adopting some method to shorten the labor of harvesting grain was early seen, and efforts were made to accomplish this end at the close of the last, and the beginning of this century. The first patent granted for a reaping machine was that to Boyce, of London, in 1799. Then followed the patent of Meares in 1800, that of Plucknett in 1805, and that of Cumming in 1811, clearly foreshadowing some of the useful improvements of subsequent patents. Smith, of Deanston, Scotland, invented a machine in

1812, which, with some improvements, worked successfully, though it had only a local reputation till 1835, when it was used before the Highland and Agricultural Society. The next model was produced by Dobbs, on the stage of the Birmingham theatre, in 1814. The handbills posted in the streets stated that the performance was for the "Benefit of Mr. Dobbs." — "J. Dobbs respectfully informs his friends and the public that, having invented a machine to expedite the reaping of grain, &c., and having been unable to obtain a patent until too late to give it a general inspection in the field with safety, he is induced to take advantage of his theatrical profession, and make it known to his friends, who have been anxious to see it, through that medium. Part of the stage will be planted with wheat that the machine has cut and gathered where it grew, and the machine worked exactly as in the field." The *Birmingham Gazette*, shortly after, said the "first experiment was completely successful."

In 1822 another machine was brought before the public, and several of the successful reapers of a later date were modelled after it. Bell, of Scotland, obtained a prize for a reaper as early as 1829. This machine remained in comparative obscurity till the World's Fair, in 1851, when the success of the American machines again stimulated the inventor to come forward as a competitor. Previous to 1851 Bell's machine had never been in general use, though used to a limited extent in the neighborhood of the inventor. Its great weight, and other defects, made it difficult to use for reaping in the field.

In the mean time, Schuebley, of Maryland, invented a machine thirty years ago, on which a patent was granted in 1833, the same year in which Obed Hussey, of Baltimore, obtained a patent on a reaper, which has

not only been extensively and successfully used, from that time to this, through the Western States, but which has furnished the basis for the most successful models in this country, among the most noted of which are those of McCormick, of Virginia, Ketchum, of New York, and Manny and Atkins, of Illinois.

The American reaping machines, some of which have been extensively used for the last twenty years, have a world-wide reputation, and a generally-acknowledged superiority, and the credit of having made the principle which the English and Scotch had invented practically useful undoubtedly belongs to our ingenious mechanics.

It is not my province to specify which of the machines lately patented is, on the whole, the best, or to point out the parts in which each excels the others. Every farmer has the means, in the reports of the various committees appointed to determine the relative merits of the machines now in use, of forming a tolerably correct conclusion in regard to these matters. The trial made under the direction of the Industrial Exhibition at Paris is still fresh in the minds of many.

This took place on a field of oats, about forty miles from the city, each machine having about one acre to cut. Three machines were entered for the first trial, one American, one English, and a third from Algiers, all at the same time raking as well as cutting. The American machine did its work in twenty-two minutes, the English in sixty-six, the Algerian in seventy-two. At a subsequent trial on the same piece, when three other patents were entered, of American, English, and French manufacture, respectively, the American machine cut its acre in twenty-two minutes, while the two others failed. The successful competitor on this occasion "did its work in the most exquisite manner," says a French

journal, "not leaving a single stalk ungathered; and it discharged the grain in the most perfect shape, as if placed by hand, for the binders. It finished its piece most gloriously."

The contest was finally so narrowed down that it was confined to three machines, — all American. One of these now gave out, leaving but two to strive for the prize.

The machines were afterwards converted from reapers into mowers, one making the change in one minute, the other in twenty. Both performed their task to the astonishment and satisfaction of a large concourse of spectators, and the jurors themselves could not restrain their enthusiasm, but cried out, "Good, good, well done!" while the people hurrahed for the American reaper, crying out, "That 's the machine, that 's the machine!" "All the laurels," says the report of a French journal, "we are free to confess, have been gloriously won by Americans; and this achievement cannot be looked upon with indifference, as it but plainly foreshadows the ultimate destiny of the New World!"

With respect to the materials used in the manufacture of reapers and mowers, particularly the latter, there is a difference of opinion as to whether the frame should be of wood or of iron. The weight of opinion seems to be that for all practical purposes wood is the better material. The iron cutter-bar has been tried to some extent, but not sufficiently to lead to its adoption in all cases. But, that the materials of which these implements are constructed should be far better than they have generally been, there can be no question. Many of the bolts in some of the machines have been made, apparently, of a poor quality of iron, while they should, perhaps, have been made of steel, and in the most per-

fect manner. A large proportion of the accidents which occur arise from the breaking of bolts and fingers. These, though apparently trifles, cause not a little annoyance and interruption. Accidents will happen, it is true, even with the common scythe; but those referred to are, for the most part, such as a more careful construction would prevent.

The manufacturer, who, for the sake of a trifling saving, slights his work on a machine newly introduced, so as thereby to retard its introduction, and create a want of confidence in the machine itself, must indeed be blind to his own interest, while he both strikes a blow at his reputation, and, what is of infinitely greater consequence, delays and retards the whole progress of agriculture.

With respect to the height from the ground at which it is best to cut grass, the practice and the opinions of farmers differ widely; for, while the answers from about half of the towns say that farmers generally cut as close as possible, the replies from others vary from four inches to one-half inch. Thus, forty-four farmers return, "as close as possible;" fourteen others, "close, or very close;" sixteen others, "from two and a half to three inches high;" ten say "two inches high;" twenty-three say "from one to two inches;" and one says "four inches;" while some say, "it might be cut too close," or "close cutting is injurious," or "most people cut too low," and many say, "close as convenient," and this is the most common practice.

It would be difficult to deduce any general rule from the replies to the question, "At what height from the ground do you prefer to have your grass cut, and why?" One farmer, of great experience and close observation, says: "I should prefer to have my grass cut high enough to protect the roots from the hot sun.

I have seen Timothy grass nearly killed by cutting close, in a dry, hot time."

Another intelligent practical farmer says: "I prefer to shave pretty close, within an inch of the ground when smooth enough. I still remember some proverbial sayings of my teacher to this effect: 'An inch at the bottom is worth two at the top,' 'you are leaving your wages behind you,' &c. Possibly, in very hot, dry weather, on a dry soil, some plants might be injured by a too close shaving; but I should not apprehend any harm, even then, and as a general rule I prefer to have grass cut as close as it conveniently can be." Another says: "Upland mowing grounds I do not like to have cut close, having an idea that the hot sun and dry weather which often follow the mowing season will have an unfavorable influence on the roots of the grass. Low and wet meadows I like to have mown close as possible. There, the heat of the sun is beneficial." — "The height from the ground at which it is best to cut grass," says a very successful farmer, "depends on the season, the soil, and the grass. No grass, except on moist ground, should be cut so low, in a very dry season, as it will do to cut it in a wet season. The natural grasses I like to have cut within about two and a half inches of the ground. Our old fields of cultivated grasses do not afford much after-feed after the clover is run out; what of stubble is left on them is lost, so I like to mow close."

One of the most observing farmers in the country says: "I prefer grass cut from an inch and a half to two inches, as it starts much quicker to grow, when cut at that height, than when shaved close to the earth, as some that are called good mowers do their work. If it is true that all crops are benefited from the ammonia in the atmosphere, as I have no doubt they are, judging

from grass side by side, the one cut close, the other two inches high, the grasses should have some leaves left them to receive this benefit. Grass cut two inches high will keep growing, while that closely cut will be even weeks before it will show the first signs of life."

Some make a practice of top-dressing immediately after removing the hay from the ground. and when this course is adopted the grass is cut quite near the surface. A farmer who takes this course says: "Where I top-dress immediately after, I cut as low as I can, to save all the grass I can. If I do not top-dress, I cut from two to three inches high, to protect and nourish the roots. I do not feed in the fall where I do not top-dress. I intend to manure all my natural upland mowing land, and never feed my old fields." And another: "I like to cut rather near the ground, for the reason that more hay is obtained. If the soil is in good condition, and not too dry, it will start again immediately. I know some say cut high, the stubble will manure the land and protect the roots; but I prefer to manure with something better for protection. I top-dress my mowing land, and prefer a compost made of woollen waste and meadow mud for soil not very wet; but for a cold, heavy soil, should prefer sand, or sandy loam, to mix with wool waste. Apply fifteen cart-loads, of thirty bushels each, late in autumn."

Thus, the testimony on this point is somewhat at variance; but many have noticed the injury inflicted upon Timothy by low cutting in dry weather, sufficient, perhaps, to establish the principle alluded to on a preceding page. Most concur in saying that the finer grasses can be cut lower with safety, particularly if the season be not too dry. Much, undoubtedly, depends upon the soil and the season.

CHAPTER X.

CURING AND SECURING HAY.

We have seen that grasses attain their full development at the time of flowering, and then contain the highest percentage of soluble materials, such as starch, sugar, and gum; and that these, with the nitrogenous compounds, then also most abundant, are of greatest value as furnishing the nutriment of animals, while woody fibre and mineral matter, though important as giving bulk to the food, are insoluble and least nutritious. We have seen, also, that, in the transition from the flowering to the ripening of the seed, the starch, sugar, &c., are gradually transformed into woody fibre, in which state they possess no nutritive qualities, and are, of course, of little value. This fact, which is perfectly well established by careful experiment and accurate analysis, confirmed, as already seen, by intelligent practice, is of great importance as indicating the condition in which most of our cultivated grasses should be cut, and our practice is pretty uniformly consistent with it.

But there is another equally instructive suggestion in these transforming processes, and it is this: If grass is cut in a condition ever so succulent, and before the transition of sugar, &c., into woody fibre has commenced, there will even then be some loss of sugar and starch from the action of heat and moisture, especially if the

grass is exposed to the rain in the process of curing, and lignefaction, or change to woody fibre, takes place to considerable extent, dependent, of course, on the length of time it is exposed to air and light; so that grass cured with the least exposure to the searching, sifting winds, and the scorching sunshine, is, other things being equal, more nutritious than grass cured slower and longer exposed, however fine the weather may be. In other words, grass over-cured, in the process of hay-making, contains more useless woody fibre and less nutritive qualities than grass cured more hastily, and housed before being dried to a crisp. There can be no doubt which of the two would be most palatable to the animal. Some loss of nutritive elements must, therefore, take place in the process of curing, however perfect it may be; and the true art of hay-making consists in curing the grass just up to the point at which it will do to put it into the barn, and no more, in order to arrest the loss at the earliest possible moment. And this fact of the loss of sugar and starch, or of their transformation into woody fibre, by too long exposure to the sun and wind, I think equally well established as that any transformation at all takes place, and as equally suggestive.

But on this point far greater difference of opinion exists among practical farmers, some considering one good hay-day sufficient, while others require two, and sometimes three, as if it were not possible to dry it too much. Our practice in this respect is, I believe, better than it used to be twenty years ago. Most farmers now think that grass can be dried too much, as well as too little, and that the injury and loss in the crop is equally great from over-curing as from housing green. A practical farmer says: "One good hay-day is sufficient to dry Timothy, redtop, or wet meadow. I think farmers

lose more by drying their hay too much than by not drying it enough."

Another writes me as follows: "As far as my experience and observation extend, I think farmers dry their hay too much, as a general thing. Grass should never be dried any more than just enough to have it keep well in the mow. I think it is best to get in hay as green as it will possibly do, for it contains more juices, which constitute its value."

This is in accordance with the experience of another farmer, who says: "Redtop is a more difficult grass to make into hay than Timothy. To make hay from any grass, it is highly important that the swaths of the hand-scythe be well shaken; here lies the secret of making hay evenly, without having green, heavy locks. If the burden is heavy, time in making the hay, if cut in the morning, will be gained by turning it by one o'clock, P. M., and then putting it into good-sized cocks while it is warm. If the weather be clear, according to my experience, this hay will do to cart the second day without giving it much attention, — the sap has become candied, and it is fit for the mow. The exposing the hay to the air on the second day, by pitching, is of essential benefit. When carted the same day it is mown, unless dead ripe, it will be withy, clammy, and will be likely to smoke in the mow; in which case the hay has lost much of its valuable quality.

"To keep it till the third day, and expose it to the rays of the sun every day, as some practise, dries out the juices, and the stem becomes hard and brittle, — the life of the hay is gone to some degree. Our mothers and grandmothers used to dry herbs in the shade; I hold to curing hay in the cock."

Another practical farmer in the same section says: "My way of making Timothy and redtop is to mow it

early in the morning, and when the dew is off spread it well. I like to dry it in one day's sun, if I possibly can; if not, put it into cocks before night, then get it into the barn as green as I can and not have it hurt. I do not want my hay all dried up; it injures it. Wet meadow I put into the barn on the day it is cut, if the weather is suitable for curing it."

Another writes, saying: "If the weather is good and the grass not too heavy, we cut in the forenoon and get into the barn in the afternoon. If the grass is heavy and the weather not good, cut in the forenoon and turn over the swaths at night; spread and get in the next day. I do not believe in drying hay as much as some do. If not quite dry, two or three quarts of salt to the load will preserve it, and it will be the better." Another says: "I prefer to cut hay in the blossom on a good hay-day in the forenoon, and it is fit for the barn, if raked with the horse-rake and care is used to turn it over and bring the green grass to the sun, by two or three o'clock in the afternoon of the same day. Much hay is spoiled by being dried too much."

"Timothy will dry sufficient for me," says a sensible farmer of my acquaintance, "in one good hay-day. I dry less and less every year. If there is no moisture on it, there is little danger of hurting after it is wilted." He cuts his swale hay before it matures and while it is quite green, and lets his upland grasses stand till they are fully developed, and commence changing their deep green color, and thinks it will keep the same stock longer and better, if cut at that age. Another experienced farmer says: "My way of making hay is to cut when in blossom, in the morning, shake it out evenly over the ground, turn it over at eleven o'clock, and get it into the barn on the same day, if the weather is good.

But, if the grass is very heavy, I put it into cocks over night. I consider it made as soon as dry enough not to heat in the mow. To get dryer than this is an injury to the hay."

One of the most extensive and experienced stock-feeders in New England, a practical farmer, says: "I prefer to cut all English or swale grass from the tenth of June to the first of July, including Timothy and clover at the same time. More than thirty years' experience has convinced me that hay secured in the above time — or just before coming into blossom — will make cows give more and better milk and butter, will put more fat on animals for the slaughter, with four quarts of meal per day, than eight quarts of meal with hay well secured from the first of July to the first of August. That will give the second crop, if you wish, time to grow, and it may be cut the last week in August, or the first week in September; there will then be a crop of fall feed, which most farmers prize very highly. If you do not wish a second crop, the feed, by early mowing, is very valuable. On the other hand, if the grass is cut late, the hay is not only poor, but the feed is mere nothing. Every farmer of my acquaintance admits that the hay cut early is far superior to that cut late, unless it be those that are in the habit of selling hay; even that class must lose in the weight of their crop by late cutting. Many buyers have not yet learned the difference between early and late cut hay, when the real difference is oftentimes from four to six dollars per ton. Working horses and oxen will keep in better condition with half the grain when fed upon early-cut hay."

Another writes me as follows: "My method is to cut with the mowing machine, which leaves the grass perfectly spread. It is turned over between one and two

o'clock in the afternoon, while still warm, and before the evening dew falls it is put into cocks. It is spread and turned the next morning, and at one o'clock is ready for the barn. I cannot tell, on paper, the precise point of dryness at which hay should be housed; but with my hands, eyes, and nose, I can judge when it is dry enough not to hurt in the mow, and not so dry as to crumble, or to have lost any more of its virtues than necessary. The less drying the better, if it does not injure in the mow." Another practical farmer says: "I prefer two days, but want to have it lay thick together, and stirred often the first day, and but little the second. In this way the hay retains more of the juices, smells sweeter, looks greener, and the cattle like it much better. Hay should be cured so that it will not heat in the mow, and no more." Another says: "Hay may generally be dried enough in one good hay-day, with proper care, to be left over night in the cock, and carried to the barn the next afternoon without spreading. Hay may be dried too much, as well as too little." "Timothy and redtop," says another, "carefully spread as soon as the ground between the swaths is dry, and, if heavy, turned about noon, will dry sufficiently in one day, if a clear one, to be put into the barn before sunset. I believe many dry their hay too much. Never dry it so as to make it brittle when twisted in the hand."

These, and many other extracts of a similar import, which might be given did space permit, indicate, with sufficient distinctness, the prevailing practice among the best farmers; but, as constantly intimated, it is very common to find hay dried far too much. Every farmer is aware of the importance of keeping his grass and hay as free from dew and water as possible. An exposure to rain washes out much of the soluble constituents of the grass, leaving a useless, brittle, woody fibre.

Grass and hay are greatly injured by remaining too long under a hot sun without being turned. A somewhat different method is adopted for the artificial grasses.

The natural grasses, when cut for hay, are generally spread and dried as rapidly as possible, in order to secure them in the best manner. Experience has proved that the same method is not applicable to the clover crop. It requires a longer time to cure it properly, and, if exposed to the scorching sun, it is injured even more than the natural grasses, since its succulent leaves and tender blossoms are quickly browned, and lose their sweetness in a measure, and are themselves liable to be wasted in handling over. Most good farmers, therefore, prefer to cure it in the cock. A practical farmer, of long experience, says: "I prefer to mow clover when it is dry, free from dew; let it wilt, and the same day it is mown fork it into cocks which will weigh from forty to fifty weight when fit for the barn. Do not rake and roll it: that process will compress it too much.

"According to the weather and my convenience, I let it stand; it will settle and turn the rain very well, and will answer to put into the mow while the heads and stalks are yet green and fresh. When fit to cart, the stalks, although green, will be found to be destitute, or nearly so, of sap: the sap has candied, and the clover will keep. On the day of carting, turn the cocks over, expose the bottom to the sun an hour or so, and to a ton of hay add four to six quarts of salt in the mow.

"Good clover — not rank — cured in this way I consider to be worth nearly or quite as much as clear Timothy to feed to a stock of cattle, and for milch cows I consider it to be by far preferable to Timothy. Good

clover hay will keep up the quantity of milk, while timothy will diminish it."

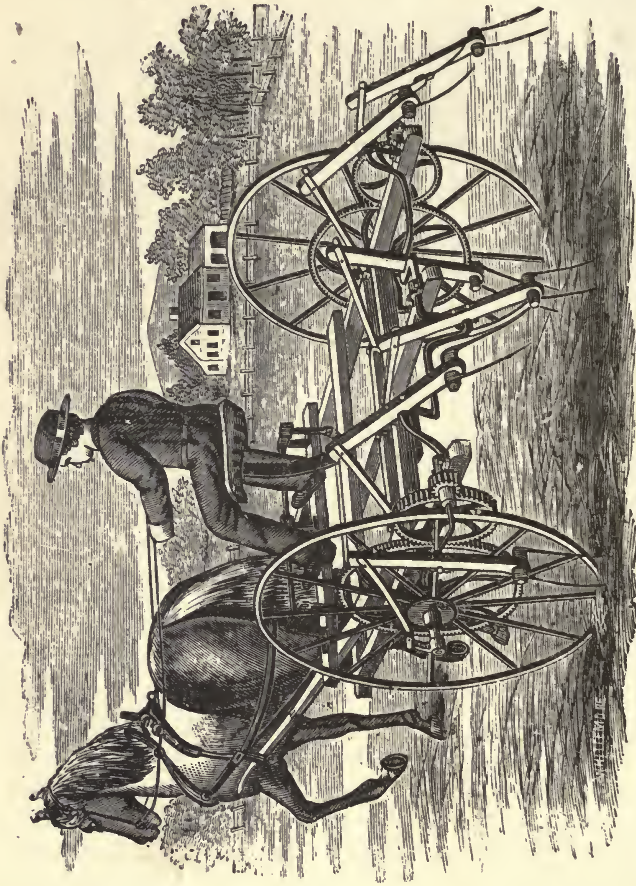

Fig. 163*a*. The Bullard Hay-Tedder.

Still another says: "I have found no better hay for farm stock than good clover, cut in season. For milch cows it is much better than timothy. It keeps horses that are not worked hard better than any hay. And

small clover, as the rowen crop, is better than any other kind for calves. Clover is not good market hay, as it wastes in removal from the barn. Stable-keepers give much more for coarse Timothy, that cannot easily be drawn through a rack." — "We mow clover in the forenoon, and let it lie in the swath, and put it into small cocks in the afternoon," says another farmer. "If the weather be fair on the third day, open it to the air and sun for two or three hours, and then put it into the barn. I have found clover cured in this way keep sweet and free from mould, and of equal value with other hay." Another says: "I have tried three different ways of curing clover. One was, to make it in the same manner of other grasses; another, to dry it one day in the swath till wilted, and then pitch it into cocks to stand some days, according to circumstances; and the third was, to give it one good day's sun, turning it over and getting out the water, and mixing it in the barn with old hay or straw. I managed in this way a year ago, the weather being very 'catching,' cut and dried it as much as possible in one day, and carted it into the barn the same afternoon. I mixed it with some old swale hay that had been left over, placing a layer of old hay, then a layer of clover, building it up in a square mow. My neighbors laughed at me, and said I should burn my barn down by putting in that 'green stuff.' But I must say I never had better clover hay than that. The cattle would eat all the meadow or swale hay, as well as the clover. There was not a particle of smoke about it, on feeding it out. When cured in this way, or by the second method, in the cock, I think clover hay is worth two-thirds as much as good English hay to feed out to farm stock."

From what has been said in these extracts, which might be multiplied, it appears evident that good

farmers appreciate the importance of so curing clover as to preserve its tender and succulent foliage. They are careful not to over-dry it, for fear of loss of the blossoms and the leaves. But it is not uncommon among thriftless farmers to handle it in such a way that the best parts of it are shaken off and destroyed.

The method detailed in the last extract, of mixing clover with a poor quality of hay or straw, has sometimes been adopted with great success, the clover imparting its fragrant odor to the hay with which it is brought in contact, greatly improving its quality, while its own value is preserved without injury. It is not only a matter of convenience, oftentimes, to have the clover so secured in catching weather, but, on careful experiment, may be found worthy of being more generally practised.

The general testimony of practical farmers, as to the value of clover hay as compared with that of Timothy and redtop, our prevailing natural grasses, varies exceedingly; some making it of equal value, others estimating it at one-half, and from that to two-thirds and three-fourths.

The practice of raising Indian corn to cut and feed out green by way of partial soiling is very common in New England, as already intimated, in speaking of the natural history of the grasses. This culture has been carried still further by many farmers, and many acres are raised, in various parts of the country, for the purpose of cutting and curing for winter use. Great hopes are entertained, by many, of the utility of the culture and use of the Chinese sugar-cane also, which, it is thought may be raised, cut, and cured, in the same way, and for the same purpose.

The common practice with regard to Indian corn for a fodder crop, and which has been already partially

stated, is to sow in drills from two and a half to three feet apart, on land well tilled and thoroughly manured, making the drills from six to ten inches wide, with the plough, manuring in the furrow, dropping the corn about two inches apart, and covering with the hoe. In this mode of culture the cultivator may be used between the rows when the corn is from six to twelve inches high, and, unless the ground is very weedy, no other after culture is generally needed. The first sowing commonly takes place about the usual time of corn planting, and this is succeeded by other sowings, at intervals of a week or ten days, till July, in order to have a succession of green fodder. But, if it is designed to cut it up to cure for winter use, an early sowing is generally preferred, in order to be able to cure it in warm weather, in August or early in September. Sown in this way, about three or four bushels of corn are required for an acre; since, if sown thickly, the fodder is better, the stalks smaller, and the waste less.

The chief difficulty in curing corn cultivated for this purpose, and after the methods spoken of, arises mainly from the fact that it comes at a season when the weather is often colder, the days shorter, and the dews heavier, than when the curing of hay takes place. Nor is the curing of corn cut up green so easy and simple as that of drying the stalks of Indian corn cut above the ear, as in our common practice of topping, since then the plant is riper, less juicy, and cures more readily. The method sometimes adopted is to cut and tie into small bundles, after it is somewhat wilted, and stook upon the ground, where it is allowed to stand, subject to all the changes of the weather, with only the protection of the stook itself. The stooks consist of bunches of stalks first bound in small bundles, and are made sufficiently large to prevent the wind from blowing them over.

The arms are thrown around the tops to bring them together as closely as possible, when the tops are broken over or twisted together, or otherwise fastened, in order to make the stook "shed the rain" as well as possible. In this condition they stand out till sufficiently dried to put into the barn.

But Indian corn stooked in this way often becomes musty or covered with dust, while the rains often soak it thoroughly and wash out much of its soluble matter, and its nutritive value is in a great measure lost. Besides, every one knows that to cut up a green plant, as a willow or any other thriftily-growing plant or shrub, and set it up with the cut end resting upon the ground, where it can still derive moisture from the soil, will prevent its drying. There can be no doubt, also, that the exposure to the sun, wind, and rain, greatly injures it, by removing much of its sweetness, or changing it to woody fibre, while it takes from it its beautiful fresh green color.

To avoid the losses necessarily attending these modes of curing, some have suggested kiln-drying as far preferable, and, on the whole, as economical. I have known the experiment tried in one or two instances with complete success, the fodder coming out with its fresh green color, and apparently better relished by cattle than that dried in the ordinary way. This method appears to me to be worthy of much more extended and careful experiment. The kiln need not be elaborately or expensively contrived. The process of drying would be short, and the labor slight.

Another mode which has been suggested is to hang it up in sheds open to the air, precisely as tobacco is cured. This process would be longer, but the nutritive qualities of the plant would probably be better preserved than if cured in the open air, with the exposure

to the frequent changes of the weather. It is hardly necessary to say that, if it is proposed to cure in this way, it should be hung up thinly, and the air should be allowed to circulate through it. After being well dried, it is taken down and stowed away in the barn for use. This method avoids the trouble of stooking, and the liability to injury from rains and dews, which blacken the stalks, though it requires considerable room, and is, of course, attended with some additional labor.

Fig. 164.

Hay, when sufficiently cured, is gathered either with the common hand-rake, Fig. 164, or most frequently with the horse-rake, Fig. 165.

This implement has come into almost universal use, and no farmer of any extent would be without one. It met with great opposition and encountered great ridicule on its first introduction; but has survived it all, and become indispensable in all thrifty and economical farming. I shall do no more than give the authority of practical farmers in answer to the thirteenth question of the circular, "*Have you used a horse-rake; if so, what patent, and with what advantage?*"

To this an experienced farmer of Massachusetts thus replies: "I have used various horse-rakes for fifteen years. Much labor is saved by the use of any kind of horse-rake that has been introduced within that time.

"Horse-rakes are on a footing different from mowing machines. Grass may be cut in the morning, in the evening, or in a cloudy day. But hay must be raked at the very right time, or it may be entirely spoiled.

It is, therefore, quite important to work quickly, when the time for doing it comes. With a good rake, a man and horse will gather more hay in half an hour than a laborer with a hand-rake usually gathers in a long afternoon, — that is, one acre; this is considered a half-day's raking by hand-rake."

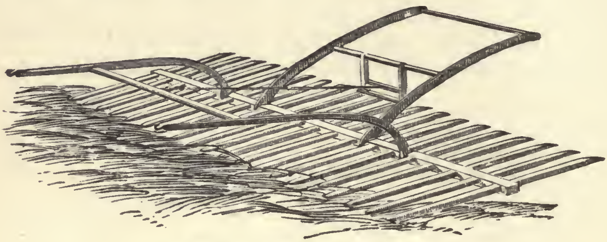

Fig. 165. Revolving Rake.

The independent rake operates very well. The old revolving rake, Fig. 165, costs about the same. One objection to the spring-tooth rake is, that the wire teeth scratch up too much earth. This is seen in Fig. 166.

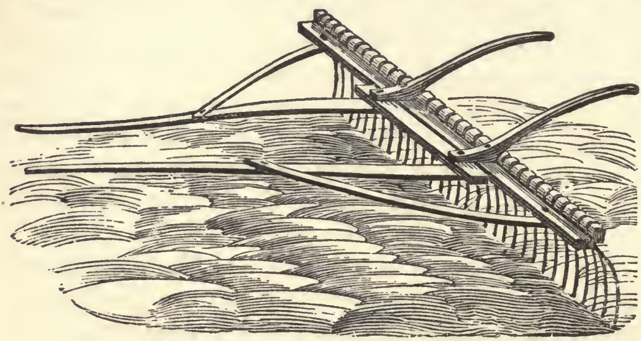

Fig. 166. Spring-tooth Rake.

These are primitive forms of the horse-rake, but they are still used in some parts of the country.

A practical farmer says: "My opinion is that no modern invention of agricultural implements has made so great

a saving over the old method of performing farm work as the independent horse-rake."

Another says: "The 'Independent' has taken the

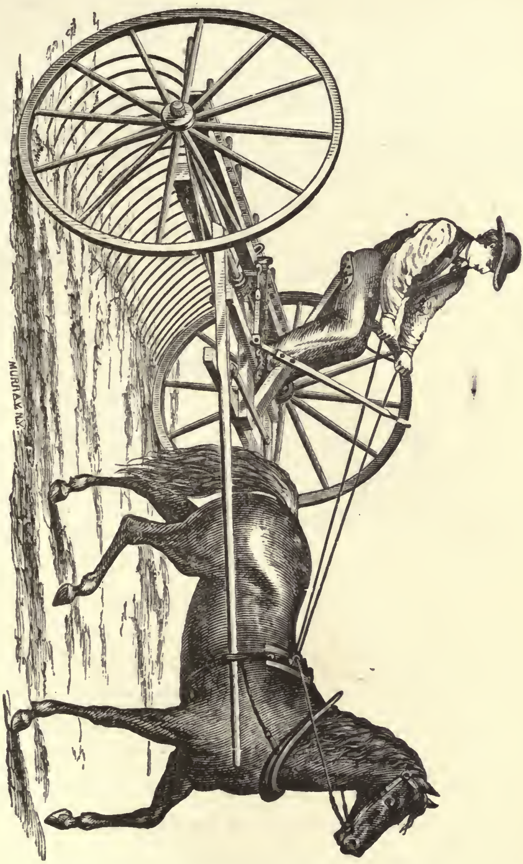

Fig. 166*a*. The Tiger Rake.

place of the revolver with me; it is managed with much more ease, the teeth, each one acting independent of all others, at all times laying on the surface, whether

even or otherwise, will rake cleaner than the revolver, and will not get so much dirt on the hay as will the spring-tooth."

And another: "I use the wire-tooth. The independent or wheel rake is used some; both are good. I cut about sixty tons of hay, and my rake I have no doubt saves me twenty dollars every year. First in labor, and second in quality of hay, — everything being raked at night." Another says: "We have used the revolving horse-rake for the last ten years or more, and my opinion is that, could I have my choice between six men or a horse and rake, after dinner, with a quantity of hay to secure, I should take the latter."

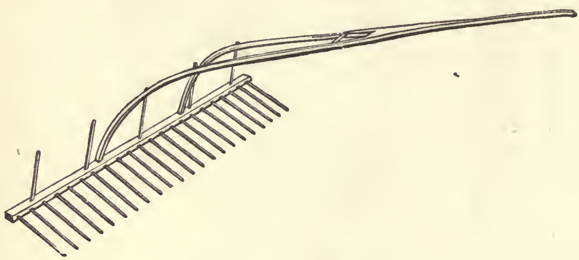

Fig. 167. The Loafer Rake.

The mowing-machine, the hay-tedder, and the horse-rake, all comparatively recent inventions, have done much to lighten the burdens of securing the hay crop, and to enable us to save time and to harvest the crop in a vastly better condition. They have superseded the old and slow methods of haying to a very large extent, and they are appreciated as among the most important of modern laboi-saving implements.

But there was still left the laborious work of pitching and stowing away in the barn or in the stack. That required strong muscle, and took much valuable time.

The horse-fork came to save that work, and to enable us to stow away the hay in much less time. To unload a ton in five minutes or less, without much expenditure of physical strength, was a very great gain.

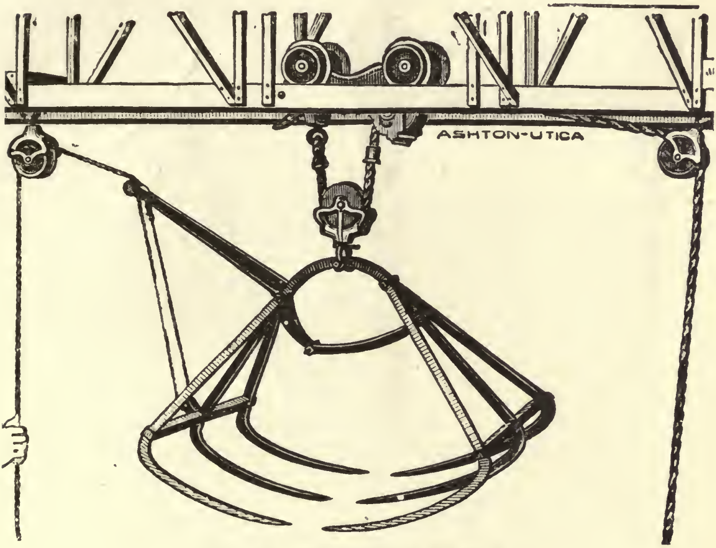

Fig. 168. The Grappling Hay-Fork.

Several different patents of horse-forks are in common use, the simplest, perhaps, and the least expensive, being the harpoon-fork and the modifications of it. By a simple arrangement of pulleys the hay is easily and quickly conveyed from the load to any part of the barn, and dropped in the bay.

With a good hay-carrier or elevator any fork may be used, and it makes little difference whether the load is under the track or twenty feet away. The harpoon-fork is easily adjusted, durable, and easily handled. It can be used for hay or straw. A double harpoon-fork is shown on p. 346.

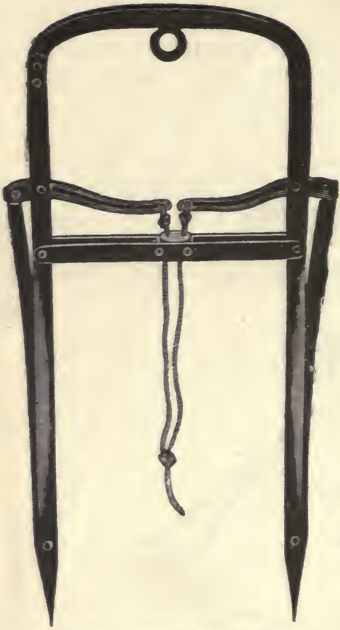

Fig. 169. Double Harpoon-Fork.

Fig. 170. The Palmer Fork.

The frequent losses to which farmers are subject in making hay have suggested the use of hay-caps, made to cover the cocks and protect them from the weather. It is but recently that their use was introduced, and, like most novelties, it has met with objections from some on the score of economy, while their use is as strongly approved by others on the same ground. I have often seen them used, and the time taken to cover an acre of grass or hay in cock partially cured is less than most would naturally suppose. Where they are to be used, less care is needed for "trimming down" the cock, and putting it in a condition to shed the rain.

An experienced practical farmer says: "I have used

hay-caps with good results. I have one hundred made of cotton sheeting, two yards square, with pins attached to the four corners with strong twine; the hundred cost me just forty dollars. I think they have saved me twenty dollars this year. I had at one time this season one hundred and thirty cocks standing out in a six days' storm. One hundred were covered, and, not having caps enough, thirty were left uncovered. The uncovered was worth but little, while the covered was

Fig. 171. Hay-caps.

passable hay. I stooked some oats, which I capped. They stood a two days' rain without injury." And another: "Our caps are made of heavy five-fourths cotton cloth, cut square, with four little loops, through which we run a slim wooden pin into the hay-cock. The pins hold it better than weights in the corner. Ours cost twenty-one cents apiece. Have saved the cost in one storm this season."

"In reply to your question as to the utility of hay-caps," says another farmer, "it gives me pleasure to

say that, after using them constantly, for the last seven years, I consider them of the first importance in the most critical branch of farming.

"I can safely affirm that my hay has been intrinsically worth, on the average, one or two dollars a ton more than my neighbors', which has been proved by the remarkable health of my animals.

"My horses have not been sick an hour, and the heaves are unknown in my stable, which may fairly be attributed to the fact that no musty hay ever enters my barn; and it is probable that the milk of cows may be as unhealthy, if they eat badly-cured hay, as if fed on what is called swill in the cities.

"Having these covers always at hand, it has been my practice to mow my grass when it was ready, without consulting the almanac, or waiting for a change of the moon; and the result has been that I have had more than my share of good luck in this important branch of business.

"They are also very useful as a protection against heavy dews, and as a cover for coarse clover and Timothy I consider them indispensable.

"After long experience, I have found the most approved method of making the hay-covers, which may be used for wheat and other grain crops with great advantage, is to take stout unbleached cotton sheeting, of a suitable width, say from thirty-seven to forty-five inches wide, — the latter is the best, — cut it into squares, and attach to each corner, by a string or otherwise, a pin made of wood, twelve or fifteen inches long, cut off smooth at one end and rounded over at the other, which completes the affair. The size of the pin should be about an inch in diameter.

"Hemming the selvages is a matter of fancy, as they would do very well without it; and, if a tannery is near

by, it would greatly improve them to plunge them into a vat for two or three days. This would thicken up the cloth an inch or two, and make it more durable, as well as much more effectual. A decoction of bark, with alum, or some other astringent, would probably answer equally as well; but this is not *necessary*, to make an excellent hay-cover. Like a cotton umbrella, the first dash of a heavy shower would cause it to spatter through for a moment, but would do little or no harm. I doubt whether a larger size than forty-five inches square, or forty-five by fifty, would be desirable. Mine have been not much over thirty-six inches square."

Another farmer says: "I have never used them myself, but they are used in the neighborhood to good advantage. A neighbor of mine, who has used them for three years, says they have been worth to him this year the whole cost, as with them he has been able to get all his hay in in good order, while a large quantity, where they were not used, was made nearly worthless by the long-continued wet weather."

A permanent structure for covering and protecting hay-stacks is described by a farmer, in answer to the question proposed in the circular, as follows: "I have a structure called a hay-cap, which, if farmers have not sufficient barn-room, I think would be economical, as hay can be more rapidly secured than in the common stack, and it obviates the necessity of fencing, and prevents the hay from being wet while the stack is open for feeding. This cap is twelve feet square, and consists of two sills, fourteen feet in length and eight inches square, four posts, five inches square and seventeen feet long, framed into the sills one foot from the end of the same. The sills are held together by two girts, framed into the post just above the sill. The posts are held firmly by

girts, placed five feet eight inches above the sills, to which height the box part of the structure is boarded. The posts above the box are perforated with holes, one foot apart, for the insertion of pins, to sustain the cap or cover. This (in form of a pyramid) should be made as light as possible, so that it may be readily raised by placing the shoulder under the corner. The frame of three by four joists must be large enough to fall outside the posts and admit of some play. The rafters are small joists, nine feet in length, the feet resting upon short pieces of joist, placed across the corners of the frame, thereby forming openings for the posts to pass. The tops of the rafters are nailed together over the centre of the frame. Girts should be placed half-way from the eaves to the point of the roof, to nail covering boards to. These should be good half-inch stuff, and run from the eaves to the rafters. The tops of the posts should be kept from spreading by stay lathing them. A hay-cap of the dimensions given will hold five tons of hay. The cost I do not know, as this was on the place at the time of my coming on to it."

CHAPTER XI.

GENERAL TREATMENT OF GRASS LANDS.

THE importance of having the ground well tilled and thoroughly prepared by liberal manuring before committing the seed to it, is too apparent to need remark. When the seed is sown, it is the common practice to harrow it in, either with an iron-tooth or a bush or brush harrow, or both; and those who adopt a more careful culture follow these operations with a thorough rolling, which compresses the soil, and usually causes an earlier germination of the seed. The importance of this last operation, that of rolling, is too often overlooked. By reference to Table XIV., the importance of covering at the proper depth is also apparent, since it will be seen that a large proportion of the seeds germinated with a very slight covering.

Many questions of a practical character suggest themselves to the farmer, after all has been done to secure a complete and thorough cultivation of the soil and a luxuriant crop, and among the first is the economy of fall feeding.

This is the term applied to feeding off the aftermath of mowing lands, a practice which is very prevalent, and justified by experienced farmers rather on the plea of necessity than any other, since most farmers, of careful observation, admit that it is, on the whole, injurious. A large proportion of those who are in the habit of fall-

feeding speak like the following, from a practical farmer, who says: "I feed off slightly, although it would probably be better for the next crop if I did not. My cows, however, like it, and, as they pay me well at the milk-pail, I like to see them enjoy themselves." Another, in answer to the questions of the circular, "Do you feed off the after-growth of your mowing lands in the fall? Do you think it an injury or a benefit to the field to feed it off?" says, "I do generally, but consider it an injury to the field." Another says: "I do feed off, moderately, the after-growth of my mowing fields, and believe the grass worth much more so fed than if left on the ground to rot. A dense mass of dead grass is also much in the way of the scythe and the rake, the next year." A practical farmer in another section of the country says: "I feed off the after-growth of mowing lands only when I am compelled to do so in dry seasons, for want of pasture. I think it an injury to feed off, unless there is a large growth, which is better to be eaten, so that it will not fall down and heat the roots and kill them."

Another says: "I feed my mowing lands in the fall, and think it is a benefit to the field in all cases where a top-dressing is used, and of no injury to an old field that is ploughed once in three or four years. Where a large growth of after-feed remains on the land, it is like mulching trees,—kills the grass-roots and makes a grand shelter in winter for mice." Another farmer says: "I feed it off and then top-dress it, and think it a benefit to the land, but should consider it an injury if I did not top-dress." An experienced practical farmer writes me as follows: "I feed it off, but think it an injury to the field to do so, and I should much prefer not to feed mowing lands at all. The grass holds in longer, and is of better quality. I feed it off because it is necessary

to eke out a comfortable support for my stock." And another: "To some extent. I do not think it beneficial to the land to feed much every year, nor very injurious to feed some; but to feed close I deem highly injurious." A very experienced farmer, of large observation, writes me: "To some extent I feed it off, not from choice, but convenience. The treading of the cattle is some injury, and they feed on the best kinds of grass, and leave the wild grasses to extend the area of their growth. In my experience, mowing grounds are kept in the best condition by taking off the first and second crops with the scythe, and biennially dressing with compost manures."

This accords with the experience of another practical farmer, who says: "My practice is to feed the after-growth or mow it. To take all from the soil without returning an equivalent, would be injurious. My custom is to top-dress my mowing grounds with good compost manure, about fifteen cart-loads to the acre, once in two or three years, — a portion of lots in one year, and a portion the next. Where the ground is not liable to wash — carry the manure off — I prefer spreading the manure in the autumn; it is dissolved by the fall rains and winter snows, and the grass is benefited in the early spring."

An experienced farmer in another section says: "Farmers here are in the habit of feeding off their mowing lands in the fall, but have no doubt that the crop of grass would be better, the next season, not to feed them. Some think the injury not so great as the value of the feed of the after-growth." — "I have had considerable experience in both ways," writes an intelligent farmer, "and do not think fall feeding is any injury, if it is not fed too close; prefer feeding to mowing the second crop, and feeding with sheep rather than cattle."

And another: "The feeding of dry mowing injures it by causing it to run out, leaving the roots exposed to the winter, while moist land is injured by the cattle's feet much more than the value of the feed, in both cases taking all off, and leaving nothing to renovate the land another season."

An experienced farmer in one of the best grazing towns of Massachusetts says: "It is now more than twenty years since I have allowed any kind of domestic animal to feed upon our mown lands, and my opinion previously has been fully confirmed by my experience. It is a decided benefit to let the after-growth remain upon the land; it is a protection from summer's drought and winter's cold. Some of my neighbors are following my example." And another: "I sometimes feed off my after-grass. When I do feed it off, I take good care to feed it early, and leave a good growth to protect the roots of the grass from frost in winter. I think it an injury to feed; mowings will last longer not to be fed at all, and the land when broken up will produce a better crop of corn or potatoes than if fed."

From these extracts it will appear that the practice of fall feeding is very general, while the good judgment of practical farmers almost unanimously condemns it as injurious, especially to feed closely and late in the season. The reasons assigned for the practice are, chiefly, the necessity generally felt for feed at that season of the year, and the importance, in some situations, — particularly on interval lands, — of removing all protection for the mice, which frequently prove very destructive to the roots when buried with the snow in winter. All condemn the practice of too close feeding, under all circumstances.

The fall growth collects the elements of a thrifty growth in the following spring. These are stored up

in the roots over winter for the early use of the plant. If it is closely fed, the spring growth must be proportionably later and feebler.

But one of the most important questions which the farmer in the older sections of the country has to meet is the proper treatment of his pasture lands. Many of our old pastures have been stocked hard, time out of mind, and the grasses in them have been literally starved out, and grow thin of necessity, while, as the finer and nutritious grasses disappear, nature very kindly covers up the nakedness of the soil with moss, as an evidence of the effect, and not the cause, of poverty. They are said to be "worn" or "run out." Many of them are grown over with bushes and briers, and other equally worthless pests, till they carry but one animal to four or five acres, and often require twice that amount to keep an animal on foot, to say nothing of fattening him. It is a well-known saying, that "poor pastures make breachy cattle."

Undoubtedly, thousands of acres in the older states would be far more profitably covered with pines than with cattle, and many an observing farmer is now convinced of this fact; but still we must have pasture lands, and there are circumstances where it becomes important to improve them, and increase their productiveness. Some of them are so situated that they can be ploughed, and thus brought in, with other cultivated lands, to the general rotation; and where this can be done, it may be, on the whole, the best and most economical mode of improving them.

In answer to the circular on a preceding page, an intelligent farmer writes me: "I have renovated my old pasture land by pulling up the bushes by the roots, scarifying the foul or mossy places with the harrow, and sowing on grass-seed and clover, both red and

white." Another says, in answer to question 16,— What is the best mode of renovating old, worn-out pastures? — "Plough, manure, and re-seed. Some have sown rye with the grass-seed, and then let the stock feed on the rye, as it will not produce any seed-stalks. It sometimes lasts three years. This method has been put in practice with marked success. On our hills, ground plaster or gypsum has brought in the white clover the next year after sowing." Another practical farmer says: "The best method I have found is to plough in forty loads of good stable manure to the acre, plant, hoe, and kill the bushes and moss, then seed down with redtop and white clover, instead of taking a crop of rye without adding anything to the soil, then seeding down with 'barn chaff,' as many do;" while an experienced farmer of another section says: "If the pasture lands can be ploughed, do it in the month of June, say seven inches deep, harrow thoroughly, sow one hundred pounds of Peruvian guano and three pecks of buckwheat per acre, harrowing them in at the same time. Sow as much grass-seed and of the kind best adapted to the soil as you please, and bush it in. I have tried twenty acres at a time with good success."

Another writes me as follows, in answer to question 16: "It can be done in various ways. I have a piece of pasture land near my house that bore hardly a spire of grass, and nothing else, except five-finger and other weeds that usually grow on old, worn-out pine plains, and I commenced twenty-four years ago by sowing Timothy and redtop, and a bushel and a half of plaster of Paris per acre, once in two years, up to this time; the grass increased from year to year, so as to cover most of the land in thirteen years. Ten years ago I commenced ploughing it. I ploughed about one acre,

and put on fifteen loads of compost manure, and planted it with corn. I sowed it down in the fall with rye, Timothy, and redtop, and sowed clover in the spring, and about a bushel and a half of plaster of Paris per acre. The next year I ploughed another part, and manured it the same, except that I planted this with melons, dunged in the hill, seven feet apart, and then sowed it down in the fall the same as the other piece. The next year I took up the remainder, and all the manure I put on the piece, except in the hill, was the water carted on it from a hole in my barn-yard. It was immediately ploughed under, then holed and dunged in the hill seven feet apart, planted with melons, and in the fall sowed as the other parts. Since that it has continued to bear very large grass. When I have turned my cattle into it, the first of June, I have judged, and others who have seen it, that, had I not pastured it, I might have cut a ton to the acre. The soil of this piece consists mostly of sand, resting upon a subsoil of gravel. Most of our pastures are spoiled by feeding off too early in the spring, and over-stocking. Cattle should not be turned in till the first of June, and then not over-stocked; so that there will always be spots of grass to go to seed, which will keep the pasture well stocked with grass. Always keep your pasture stocked with grass. If you cannot keep it on any other way, sow on Timothy and redtop, and harrow it in, once a year. I prefer to do it in August; but any other month in which you are most at leisure will do."

Another experienced farmer says: "Old pastures should be ploughed and planted when they are not too rough for those operations. They may then be seeded down in July among corn or beans, or grain may be sown with the grass-seed in the following spring. But we have too much rough pasture unfit for the plough.

It should never have been cleared for pasturing, but should have been left to run to wood. Such rough lands are often much improved by sowing plaster at the rate of two hundred pounds per acre. Plaster generally works well on clays and clayey loams, which are not wet." And another: "Where I have ploughed and planted old pastures, and then seeded anew, the cattle get a much better living." One of the best farmers of my acquaintance, in reply to the same question, says: "Either by ploughing, rolling, and sowing down grass-seed and grain in September or April, or ploughing in manure, after removing the crop on old ground, and cross plough in the spring, then spread and harrow in guano, at the rate of three hundred pounds per acre, or a good dressing of compost, and sow Rhode Island bent, or redtop, and white and red clover, with some variety of grain; or by scarifying mossy ground, and sowing in grass-seed and harrowing it, then applying three hundred pounds of guano, or one bushel and one peck of salt, or ashes from ten to twenty bushels per acre, harrow and bush the ground. Sow early in fall or spring."

A farmer, who has lived and had a large observation in England, says: "Some farmers say the plough. But in England, where old pastures are seldom broken up, I have known extraordinary results from top-dressing with crushed bones, more particularly on the large dairy farms in Cheshire. I am sorry I cannot give you the quantities. A neighbor of mine has harrowed an old, worn-out pasture, dressed with a liberal coating of Barilla ashes, from six to seven cords per acre, and sowed white clover, and rolled it. It came out a beautiful pasture. The brush harrow and roller, applied to all grass land in the spring, will amply repay for the labor. Breaking and spreading the cattle droppings on

the pasture land is well worth attending to." The methods of renovating pastures by top-dressing will be alluded to hereafter.

A farmer of Massachusetts says, in answer to the sixteenth question of the circular:

"This depends on the kind of land to be reclaimed. If it can be ploughed, I would plough it and plant it with potatoes or something else, to make it mellow and fine, and then sow it to grass. If it is too rough or stony to plough, — which is the case with a large share of the pasturing in this section, — but is good, sweet, warm land, I would feed it with sheep. I have a pasture of this description, that, a few years ago, was covered with briers and bushes so thick that there was but very little grass upon it. I cut off the bushes, and put on sheep enough to eat everything that grew upon it for four or five years. They have killed all the briers, and most of the bushes. I have sowed some plaster of Paris, which is all I have done to it, and now one acre is worth and will produce more feed than three would ten years ago. I should say that my sheep have always done well on this pasture. If the land is cold and wet, and inclined to grow bushes, I let it go, and never try to reclaim it, unless it is near the buildings, or near the village, where the land is very high. In that case it may pay to ditch and work it into good smooth land."

Another practical farmer, of great experience, says: "We have a variety of soil in this town; some of the best of pasture lands, stony soils, generally clay subsoil. Plaster of Paris is our renovator for pasturage. It works most admirably on almost all of our lands. Two hundred pounds to the acre, applied once in two or three years, in early spring, will keep our pastures good." And another: "The best method I have ever

used is to fence in small pieces, and then stock hard with sheep. Feed it down till no green thing remains; then turn the sheep off days and on nights till September; then harrow the land with a sharp harrow, and sow on grass-seed, keeping the cattle off the remainder of the season."

"It will improve an old pasture merely to plough and re-seed it, without manure," says another; "but this is a slow mode, and not to be recommended where it is possible to apply some sort of dressing. A better method is, without doubt, to plant for a year or two, manuring well, before sowing grass-seed. The soil, by being thus thoroughly stirred and exposed to atmospheric influences, will give a sweeter grass, and perhaps more of it. But it is not always convenient to plant a part of a pasture. In such cases great benefit would result from simply ploughing, manuring, and seeding to grass immediately."

But perhaps the best disposition that can be made of many of our poor, thin pasture lands, and one which has incidentally been alluded to, is to take the cattle from them entirely, and cultivate them with forest trees. This is frequently recommended, in answer to the question proposed in the circular. One farmer speaks in the following words: "Old, worn-out pasture lands, that cannot be renovated by gypsum or ashes, had better be suffered to run up to wood. Pine lands can be seeded in the fall with a crop of winter rye, or without. Pine-seed can be obtained by taking pains to collect the burrs before they are open, and drying them in some place where they can be threshed. This is white-pine-seed year."

This, I am convinced, will be found to be perfectly practicable, and a rapid growth of pine wood, intermixed, as it should always be, with some deciduous

growth, like the white birch, will be found to be more profitable than the use to which pastures are now generally put.

I know many pastures, of good, strong soil, never ploughed within the memory of the living, some of which are known not to have been ploughed for a hundred and fifty years, which require from eight to ten acres to a cow, so entirely buried are they in moss and bushes. Such lands can be planted with pines at a small cost, and would soon be covered with a growth which would pay a large percentage on the outlay.

I have examined over a thousand acres of cultivated pines, in different parts of the country, varying in age from three months to twenty years, and can testify to the surprising rapidity with which such a plantation will cover the ground, concealing the fact of their being planted by the hand of man, and assuming the appearance of a dense forest.

In one instance, the owner informed me that his plantation had averaged him a cord to the acre every year, for twenty years, during which it had been planted, while the land, a light, barren sand, had apparently been improved, and a thick undergrowth of hard wood was evidently ready to succeed the pine, when the opportunity offered. I have seen a growth of pitch pine, made in one year, of over two feet six inches in length, by measurement, and a growth of white pine, made in the same time, of two feet nine inches. The growth of wood is generally interrupted by the drought, during the hottest months of summer, and then starts out a new growth in the autumn ; but, in very moist seasons, it continues, with extraordinary vigor, all through the season. The average growth would not, of course, equal that stated above.

But still there are circumstances, and they are not by

any means unfrequent, where it is both practicable and desirable to take other methods of improvements for pasture and grass lands.

The idea was formerly entertained that pasture lands were sufficiently enriched by the animals which fed them. Practical men begin to think otherwise; for it is found that a profitable return is made for the little outlay which they require. Particularly is this the case with pastures fed by milch cows. They do not return the essential elements of the plant to the ground in so large a proportion to what they take from it as some other animals. These elements are required in great quantities to form their milk, while in other animals they are required only to form bone and muscle. The manure made by cows is, therefore, less valuable and fertilizing than that of some other animals. The consequence is, that lands fed wholly by cows are exhausted sooner than those fed by other animals. For it is evident that where more is taken from the soil than is returned, exhaustion must follow.

We furnish animal and vegetable matters to the earth to supply it with substances which the growth of plants has taken from it. It will be obvious, on a moment's reflection, that the constituent parts of the plant are taken up from the earth and the air, in somewhat the same manner as our food and drink become our bone and flesh. The analogy is still more distinct when we reflect that all our applications for the improvement of the soil are nothing more than the supply of food for plants. For the food of plants is found in all manures, and the value of these depends upon the quantity they contain.

The methods of renovating mowing and pasture lands by means of top-dressings do not essentially differ. An interesting experiment fell under my observation not long ago, where common meadow mud, rich barn and

liquid manure impregnated with lime, were used as a top-dressing on different parts of the same field. The mud was hauled out in the autumn and thrown in heaps, and there left to the action of the frosts and snows of winter. In spring it was spread about the same time the other manure was applied. Strange as it may seem, the top to which the mud was applied appeared to far the best advantage. The grass was heavier, and, after the crop had been removed, that part of the field on which the mud was applied came in more quickly and luxuriantly than the rest. This field was a light, gravelly soil, which had not been under very high cultivation.

Many of our soils are gravelly, with a mixture of sand. These soils need a mixture of marl and meadow mud. Marl and mud contain the carbonate, or in some cases the sulphate of lime, or plaster of Paris, and often a mixture of clay, which sandy or gravelly soils need. On these soils clayey mud has been found to do the best. Peat mud is a rich vegetable food; and if a small proportion of potash, or ashes, be added, it is valuable as a manure.

Light soils are always improved by any substances which make them firmer and more compact. Stiff clay soils, on the other hand, are benefited by applications which make them lighter and more permeable. No one of the three kinds of earth, sand, clay, and lime. when unmixed with the other varieties, would be capable of supporting vegetation. The mixture of them, when any one predominates, will correct and improve them; since it is well known that the fertility of soils depends upon the relative proportions of their different constituents. In some marls the clay predominates, and these should be used on the light, sandy soils; in others, the sand predominates, and these are adapted to stiffer lands. The practice of mixing soils has always been attended

with success when judiciously managed, and it offers a practicable means of improvement.

Nor is this application of mud and clay any new fact to the practical agriculturist. The county of Norfolk, in England, is said to owe much of its great fertility to this source. The greatest European improvements in sandy soils have been made by these means in Belgium. As intimated in the experiment alluded to, it has always been found best to expose the mud or clay to the action of the frost. It becomes mellowed so that it may be spread evenly upon the ground. Peat mud is composed of vegetable matter which has been accumulating for ages. When taken fresh it is found to contain an amount of acid which would make it improper for immediate use. Exposure to the frost, wind, and rain, will, in time, entirely neutralize the acid properties. Ashes, or potash, would have the same effect in a much shorter time.

These substances may be said rather to ameliorate and improve the texture of soils than to furnish immediate sustenance to the plant. And in this view they cannot be too strongly recommended; for we have never known them to fail of having beneficial effects, both on pasture and mowing lands. And, besides, the application of them is so simple, so much within the reach of every farmer, that it is well worth the trial. If the soils are much worn, or very barren from a great preponderance of any particular earth, a liberal allowance will be required; but, ordinarily, as in the experiments which have come under my notice, some twenty-five or thirty cart-loads to the acre have been found sufficient to increase very greatly the productiveness of the land, while a still less quantity would be of essential service. Nor is the expense of this application so great as some imagine; for almost every farm contains a

quantity of waste peat meadow, and clay is frequently near at hand. It may be removed and prepared at a season of the year when there is but little else to do. The expense, therefore, need not deter any one from its use.

But there is another substance equally accessible, which acts both as an ameliorator and a fertilizer of the soil. It is, perhaps, one of the cheapest and most profitable top-dressings. It is the rich loam which accumulates in the holes by the road-side, and wherever the wash gathers from hills. Every one has observed the effect of the loam thrown out upon the grass in ploughing. The grass along the edges soon becomes greener in spring, and grows with greater luxuriance. The wash by the road-side would have a far more powerful effect. For this contains, besides the putrescent animal matters from the road, a quantity of fine sand, which rich soils, wanting closeness and consistency, require on the surface. Spread upon such soils when covered with grass, it is very efficacious, and often makes the vegetation as vigorous as stimulating manure. Experiments have clearly shown that the effect of sand on some soils is to operate as a manure.

Among the mineral manures, lime has sometimes been used as a top-dressing. Its effect arises not so much from any direct nutriment furnished by it to the grass, as from its influence on the substances in the soil. It hastens the decomposition of vegetable and mineral matters in the earth; and in this way it may be said to renew exhausted soils. It increases the temperature of cold, sour lands, after being drained, and causes a rapid decay of peat substances. Hence its use in the compost heap. It destroys the mosses and coarse herbage which work in among the grasses, and indicate the want of lime in the soil. It produces from them a fine

vegetable mould, by causing the white and red clover, and some natural grasses, to come in thicker and thicker each year. Lime produces a more marked effect on the grasses than on any other crop. It seems, very frequently, to increase the nutritive quality of the grasses, as well as to increase their quantity, by assisting them to elaborate the juices, the albuminous substances, and the sugar, in which their value as food for stock largely consists.

But lime can never supply the place of other manures. There are properties which it cannot supply, which plaster can; others which it cannot supply, as bones can; and others which it cannot supply, like ashes, and manures that contain salts. There are situations, however, in which it is invaluable. On reclaimed meadow lands, after thorough draining, and a covering of three or four inches of gravel, a top-dressing of lime has a beneficial effect. Crops of grass of two and three tons to the acre have been taken after such a dressing of lime. In many cases the first crop will repay the expense of bringing such land into cultivation. In these situations, then, as well as on many pastures, it may be called one of the most useful applications that can be made. Such lands will bear an abundant supply of lime without exhaustion. But on poor, sandy soils it should never be used. It will soon exhaust and may render them completely barren. When it meets with clay in lands to which it is applied, it forms a kind of marl, and greatly improves the texture of the soil; but, when it comes in contact with sand, it forms, rather, a sort of mortar. Hence it is thought to be injurious on sandy soils. Many soils have naturally a sufficient quantity of lime, and on these a further application is not needed.

No definite rule, with respect to the amount required, can be given. It must depend upon the nature of the

soil, and must be left to the judgment of those who use it. In general, on peat and clay soils, from ten to fifty bushels to the acre will be required, though less would, perhaps, be beneficial.

The addition of lime to the compost heap is often of great importance. The decay of all vegetable substances is accelerated by it; but it should not be brought in contact with decaying or fermenting animal substances, unless covered by a thick coating of peat or other absorbent. Whenever lime is used in a compost, — unless it be for the special purpose of hastening the fermentation of vegetable substances, — it ought to be mixed with salt, by dissolving the salt first in water and slacking the lime with it. A bushel of salt will thus prepare four bushels of lime. Refuse brine will answer very well.

We come now to the use of ashes as a top-dressing. Of this we may speak with more confidence; for, while experiments with lime have not invariably proved successful, owing, probably, to the soils designed to be benefited, we know of no instances in which the application of ashes has not fully repaid the expense. If farmers would bear in mind that ashes contain most of the elements which assist plant-growth, they would be unwilling to part with a substance which they might turn to such profit. If the quantity is small, let it be husbanded with the greater care, instead of being sold, with the idea that so few can do no good. One substantial farmer says: "I am now, more than ever, fully persuaded of the value of ashes as a manure. Nothing in the whole catalogue of manures compares with them on my land. The soil was a thin, clayey loam, and where the ashes were sown there was a crop of excellent clover, where for years the land had been almost unproductive."

Grasses are often more benefited by ashes than other crops, since they require a greater amount of the salts which ashes contain. For all permanent mowing lands, especially on the lighter soils, ashes are among the cheapest of manures, where they can be had in sufficient quantities. In parts of Flanders and Belgium, countries in which the science of agriculture has been carried to a high perfection, the great loss of inorganic matters from the soil is constantly restored by ashes or bones, together with other manures to be mentioned hereafter. Indeed, almost all agriculturists, both in Europe and America, have attached very great importance to the use of ashes. In some parts of Germany they are held in so high esteem that they are transported to a distance of eighteen or twenty miles, to be used as a top-dressing.

According to Professor Liebig, with every one hundred and ten pounds of leached ashes of the common beech-tree, spread upon the soil, we furnish as much phosphate as five hundred and seven pounds of the richest manures could yield. Now, phosphates are highly useful to all kinds of soil.

There can be no doubt that the process of leaching takes from the ashes a part of their fertilizing properties. For many uses this is no objection. Especially is this the case near the sea, where leached ashes are thought by some to be even more serviceable, as the gas in the atmosphere the more readily combines with them. Every practical man has heard of the amazing effects which bone-dust has upon the soil. Yet this is valuable chiefly for the phosphate it contains. But, if we may rely upon the statement of Professor Liebig, leached ashes also contain a large amount of phosphate of lime, which would show them to be extremely valuable. But, suppose we allow four bushels of leached ashes to one bushel of crushed bones, the expense of

the ashes would, in most cases, be less than the bones. But, if bones can be procured, a mixture of leached ashes and bones, four bushels to one, forms a very useful application. The compound should remain a week or two before being used.

Those who have tried leached ashes have been fully satisfied of their superior qualities as a fertilizer. Careful experiments, by practical, conservative men, show that land producing one ton to the acre has been so improved by this means as to yield three tons to the acre. Where thirty bushels were used on three-fourths of an acre, in one instance, the crop was increased more than three-fold. Nor are leached ashes subject to the objections which are raised by some against the use of lime. They do not apparently exhaust the soil. The effect of them is felt for several years. Many farmers have found, by experience, that one bushel of unleached hard-wood ashes is nearly equal to two bushels of plaster, as a top-dressing for the drier grass lands. If this be true, what has been said would show that leached ashes are about equal to plaster in their effects on such lands. A peck of lime is commonly used in leaching a bushel of ashes. This, of course, adds to the value of leached ashes for grasses. They contain, also, a portion of the alkali which is decomposed by the action of the atmosphere, and the water in the soil prepares it for the food of plants.

As we have already spoken of the use of peat mud, it is proper here to say that ashes may be mixed with mud in the proportion of six or eight bushels to the cord. The mud is better, as usual, dug in the autumn, though the mixture might be made in the spring, or on application to the soil. If leached ashes are used, the proportion may be about one to three. In this case the two substances mutually assist each other, and the

compound is, perhaps, better than either alone would be. So potash, added to peat mud, makes a valuable compound.

In this connection allusion might be made to the practice of burning sea-weed as a manure, and spreading the ashes upon grass and pasture land. They form a very useful and powerful stimulant, but the process of burning causes the loss of some of its most fertilizing qualities. The most common and efficient mode of application is to carry it directly upon the grass as a top-dressing. The coarse rock-weed and kelp decay in a much shorter time than the fine sea-weed, and are no doubt far better than this. Sea-weed is best on sandy or gravelly soils, where from twenty-five to thirty, or even forty cart-loads to the acre, are sometimes applied. Peat ashes form, in some cases, a very valuable top-dressing for grass and pasture lands. In Holland, where every fertilizer is preserved with care, peat ashes, as well as wood and coal ashes, are highly esteemed. The great value of the first is well known to many, and if those who have them will spread them upon grass, at the rate of fifteen or twenty bushels on the lighter, and thirty or forty on the heavier soils, they will be abundantly repaid.

If what has been said be true, — and it is the result of many experiments, some of which have come directly under my own observation, — farmers would do better to buy ashes, on the return of every spring, than to sell them, as is often done in some sections of the country.

Of the use of gypsum, or plaster of Paris, the most contradictory opinions have been expressed. So far as my observation goes, — and I have both seen and tried many interesting experiments on old pasture soils and mowing lands, — the application to moist soils has been satisfactory. It has been said that plaster does not

benefit natural pastures. This, I apprehend, depends chiefly on the character of the soil. In one instance, within my knowledge, a large pasture, which had become worn and somewhat unproductive, received a generous top-dressing of plaster. The grass started sooner, and continued throughout the season to look far better, than the adjoining pastures of precisely the same soil. So far as could be ascertained, the increase in grass over the adjoining pastures was about seventy-five per cent. Nor was this all. This pasture came in the next season with the greatest luxuriance, and its load of beautiful green was the wonder of the neighborhood. Its effect on clover and Timothy is even greater than on old pastures. Many have supposed that plaster would exhaust the soil. That this could not be the case will appear from the fact that it takes four hundred and thirty parts of water to decompose one part of plaster, while its decomposition is so slow that its influence is felt for several years. How, then, can it have such immediate and beneficial effects? It is generally explained by saying that it retains the fertilizing gas, which is constantly rising from fermenting vegetable matter, and gives it up, at a proper time, for the nourishment of the plant. It does not, like lime, cause vegetable matters to decay, but rather, when they decay, holds their most important parts from escaping.

The infectious odor which rises from decaying vegetable matter, from the stable, from the manure heap, and imperceptibly from the whole surface of the earth, is one of the most important elements for the growth of the plant. Plaster fixes this, and the first shower washes it into the earth to feed the roots of plants. The relative value of manure depends, in a measure, according to the generally received opinion on this subject, upon the amount of this noxious odor, or the

ammonia which it contains. Ammonia, commonly known as hartshorn, is an exceedingly powerful stimulant. Nor will it appear unimportant, when we bear in mind that two and one-quarter pounds of this ammonia, lost by fermentation, is equal, according to some, to the loss of one hundred and fifty pounds of grass or grain.

Scientific men will say that this gas is taken up in the atmosphere by the rain, and descends with the rain to fertilize the earth; and this is probably true. This ammonia, so valuable, so indispensable to the earth, is not lost forever when it flies away into the air; but the shrewd farmer will perceive that as much of it as he allows to escape from his own hands, by neglect, falls upon and improves the fields of his neighbor as much, and perhaps more, than his own. Is it not evident that, by saving all that we can, and by receiving whatever the genial rain brings with it, we get a double benefit?

If the effect of plaster is such as has been described, no one can fail to see how important are the functions it may be made to perform. But it also adds a certain amount of lime and sulphur to the earth. It is composed of these substances for the most part, and hence called by chemists sulphate of lime. I shall have occasion to speak of its use in connection with other manures in the compost heap, and I now allude to its use by itself, simply as a top-dressing.

On some soils it is not so satisfactory as on others; but our pastures are, many of them, covered with the white clover or honeysuckle, and these are often called clover lands. On all such lands, whether reserved for pasture or mowing, plaster generally has a wonderful influence. A bushel, or two bushels, to the acre, have been known to double the crop, and to add more than twenty times its own weight to it, while even greater results have followed. For, if we may believe Bous-

singault, one of the most distinguished chemists, every pound of nitrogen which we add to the grass increases the produce one hundred and ten pounds; and this increased produce of one hundred and ten pounds is effected by the aid of a little more than four pounds of gypsum, or plaster. Another accurate investigator, Sir Humphrey Davy, found, by actual experiment, that the ashes of an acre of red clover contain no less than three bushels of plaster of Paris. This important fact proves that the earth already contains a large amount of this substance, and that it is essential to the growth of clover. This may, perhaps, explain the so-called clover sickness in some land. The requisite supply of plaster has been exhausted. In any case, the addition of plaster to clover lands, and especially to pastures, is of the highest importance.

The effect of charcoal is somewhat similar to that of plaster. Charcoal will absorb ninety times its own bulk of ammonia, which is held from escaping till it is separated by water, and carried into the earth for the plant. When dry, the operation of fixing the gas is repeated, till the next shower sends the gas into the earth, and the particles of water take its place in the charcoal. In this way, as a top-dressing, charcoal, as well as plaster, performs the most important functions. If we take any decaying animal matter, which has begun to give off its offensive and noxious odor, its ammonia, and cover it with charcoal or plaster of Paris, this escaping gas is immediately stopped. No infectious odor arises from it. The decay of the substance has suddenly ceased. This simple fact will show the intelligent farmer to what purposes these substances may be applied. His choice of these should depend somewhat on the expense of procuring them. The relative expense depends so much upon circumstances, that I need not make the estimate.

As an absorbent and retainer of the valuable properties of manure, peat mud and loam will also be found of essential service. If used on a high and dry soil, the effect of plaster will not be very apparent the first season, unless there are frequent rains.

There is an impression among many that plaster does not produce so good results in the immediate vicinity of the sea-shore. If this is so, it does not arise, probably, from the proximity to the sea, but from other causes. Many of our lands do not need the application of plaster; but I have seen it used, to the best advantage, within two miles of the sea. If there were anything in the sea air to prevent plaster from performing its usual functions as an absorbent, the effect would be perceived to a far greater distance inland. If any failures have occurred in its use in the vicinity of the sea, they were probably owing to the soil rather than to the atmosphere. There is one other remark in this connection. When plaster has been applied without immediate effect, we should not at once conclude that it is useless on the particular soil to which it is applied. The first season may be dry, and ill-adapted to its decomposition. In such cases good results have ordinarily followed the second year.

The great utility of bones as a manure arises from the large amount of phosphates which they contain. On all pastures which have been long fed the phosphate of lime is exhausted. It is constantly taken from the earth in the grass, to form the bone, the muscle, and the milk of animals. Of the earthy matter in bones, nearly five-sixths consist of phosphate of lime and magnesia. Nitrogen is also abundant, and, of course, ammonia, for nitrogen is an element of ammonia. A few bushels of bone-dust will often quite restore old, "worn-out" pastures. Indeed, almost every part of which

bones are composed goes directly to the nourishment of vegetable life. The ashes of all grains are very rich in phosphate of lime. This shows the importance of furnishing this element for their use.

A mixture of crushed bones and ashes, or leached ashes, forms a valuable top-dressing. Nor will this application, in small quantities, be thought expensive, if what is said be true, that the animal part of bones, which amounts to about one-third, contains eight or ten times as much ammonia as the manure of the cow. A small quantity of bone-dust will answer the purpose, in some respects, of a larger quantity of manure from the stable. We can but hope that every farmer will try the experiment. It may be done on a small scale at first, though in the vicinity of every butcher's establishment bones can commonly be procured in any quantity.

Thus far I have spoken of manures which belong more peculiarly on the surface, as a top-dressing for grass. For, though they are sometimes used, especially plaster, on ploughed land, with potatoes and other crops, yet their influence on the surface is thought to be far more effective. Indeed, the benefit of lime, plaster, and charcoal, would, in a great measure, be lost, were they to be buried to any depth in the earth. But there are other manures which are often used as top-dressings.

One of the best practical farmers in the country says. "I top-dress almost all of my mowing in the fall, cut two crops on all of them, and on some a third. I make a compost of earth and manure; make in the lot where it is used, by ploughing off a thin turf on the lower side of a small hill or knoll, taking the turfs to the hog-yard, and then cart from the stable three, five, or ten loads, or more, as I have the manure. Drop the manure

upon the ground that the turf was removed from, then plough on the upper side of the hill, and shovel two loads of earth upon each load of manure, beginning in the spring, and so on through the season. As the manure of the barn increases, cart to the meadow, placing it upon the upper side of the first heap, and plough and shovel as before. From one hundred loads of good stable manure it makes three hundred loads of good compost, and will make as much grass as so many loads of stable manure. For grass, put ten cart-loads per acre. Spread in the fall upon mowing, this compost makes more grass than green manure, carted and spread upon mowing in the spring. In almost all cases the knoll or hill carted until it is level with the adjoining ground produces more crop than before."

Another writes me as follows: "Top-dressing for mowing lands is very beneficial, but too expensive, if barn-yard manure alone is used, so much passes off by evaporation. A compost of one-half or two-thirds turf, or swamp muck, and one-third good manure, is quite as beneficial to the land, and probably better or more enduring than all manure. If ashes are mixed in this compost, it is all the better. But, if stable manure alone, or in compost, is to be applied, it should be in autumn, so that the frosts of winter may incorporate it with the soil."

Another farmer, of great experience and observation, says: "I top-dress generally late in the fall, but should prefer early spring dressing, if we could cart on the field without injury, and the time could be spared from other business. My land is chiefly of a cold, tenacious soil, and a compost is made of one-fourth stable manure and three-fourths light loam. For warm land, peat mud would be used instead of the loam. Twenty common ox-cart loads, from thirty-three to thirty-five bushels

each, to the acre, is as small a dressing as can be judiciously applied. Double that quantity would not be excessive." "With respect to top-dressing for mowing lands," says another practical farmer, "I would state that for several years we have been in the habit of raising from one to three acres of early potatoes for market. We have usually dug them early in August, and before the tops were dead. The tops are taken directly from the field, and spread on the mowing lands to very great advantage. We think the tops from an acre of potatoes sufficient to top-dress an acre of mowing land, and the effect is equal to three or four cords of good manure."

The practice alluded to in this extract is worthy of a careful trial by those who are so situated as to adopt it. It is known that the tops of potatoes contain a large percentage of the organic elements of plants.

Fromberg found in one hundred pounds of the leaves, in a natural state, from .82 to .92 per cent. of nitrogen, and that one hundred pounds of leaves dried contain from 5.12 to 5.76 per cent. of nitrogen. If his results are correct, — and there is no reason to distrust them, — we add to the land fifty pounds of inorganic salts, besides nearly twenty pounds of nitrogen, among the organic constituents of every ton of potato-tops. This would make a ton of them equal in value more than two tons of the best Ichaboe guano.

In a case which I have in mind, a very poor, worn-out grass lot was top-dressed with fourteen ordinary cart-loads of good stable manure to the acre. The quantity of grass was increased four-fold. Clover and Timothy came in as luxuriantly as on any new-laid piece. If the top-dressing were repeated once in five or six years, there would be no danger of exhaustion, though there would be an advantage in loosening the

earth with the plough. But the use of stable manure should be confined mostly to mowing land. On closely-fed pastures it would be injudicious, from its exposure to the sun. On these, ashes or plaster would be better.

One experienced farmer, in answer to the circular on a preceding page, says: "Peruvian guano, mixed with loam, is unquestionably the best manure for top-dressing that can be found. Ashes are very good for lands that are liable to be washed by the fall and early spring rains. I should think that the spring would be the best time to spread it; but on lands not so situated the fall would be more proper. In the latter case, the manure would be entirely mixed in around the roots of the grass, and all the strength of the manure would remain in the ground."

Another experienced and intelligent practical farmer writes me: "I top-dress moist mowing lands in winter or early spring, with eight or ten loads of fine manure, or with about three hundred pounds of guano, mixing the guano with twice its bulk of dry sand, moistened with water, containing about two ounces of sulphuric acid in solution to the gallon of water."

No farm should be managed without a compost heap, since it may be so made as to form an extremely valuable article for top-dressing. A quantity of meadow mud should be dug out in the autumn for this special purpose, where it is practicable. Two cords of peat mud, added to one cord of good stable manure, will make, in the estimation of many practical farmers, a compost of three cords of valuable manure. This has been tried repeatedly, and is constantly done by those ambitious to excel in farming. To this compost heap should be added, from time to time, all the animal and vegetable matter adapted to ferment and enrich the soil. Woollen rags, the remains of fish, the blood and flesh

of animals, the hair of animals, all these make an exceedingly rich manure. A most intelligent gentleman, connected with a wool factory, informs me that a cord of matter collected at the establishment is worth at least five or six cords of the best stable manure, for a top-dressing. This we cannot doubt; for here are the blood, the wool, pieces of the skin of the animal, a little lime, and many other substances, all collected together. A fermentation takes place, by which the richest gases are formed. Such a compost heap, with an addition of loam and mud, would be invaluable for a top-dressing. But, though in most cases all these substances cannot be procured, many of them can, and should be saved by every one who is desirous of improving his land. Those who are near the sea, or near the market, can procure an abundance of fish to add to the compost. Nothing is better for soils than this. A little lime added to the heap causes its rapid and thorough decomposition. Ashes should also be added. When additions of manure are made, they should be covered with mud or loam, to prevent waste.

We need not enter more minutely into the details of forming the compost heap. It is sufficient to say, in a word, that everything capable of fermentation should be added to it. The lower layer should be of loam or mud. Nothing is more common among farmers, on the death of a horse or any other animal, than to throw the body away. It is estimated by some that the body of a single horse, when divided and mixed with peat mud and loam, will make a compost worth fifteen or twenty loads of the best and richest manure. This is, perhaps, too high an estimate; but animal substances ferment rapidly, or rather they may be said to putrefy without fermenting, so quick is their decomposition. If leaves, grasses, moss, straw, and other substances of like

nature, are used, lime will be useful in causing their rapid decay. When these are well fermented, the heap should be thrown over, and if made long and narrow, so as to expose the greater surface to the air, it will be the better.

The value of a compost, properly made, is greater than the aggregate value of the several ingredients applied separately, no matter what or how rich they may be. Besides, some divisor is needed for concentrated or other powerful manures, by means of which they may be more evenly and judiciously applied. Peat, or dry meadow muck, is one of the best and most available of these divisors, if properly prepared by exposure to the influence of air and frost. No good farmer would ever use lime in compost with barn-yard manure or animal substances, unless peat muck, gypsum, or charcoal, were largely used in the same mixture.

Animals fed on rich food make far the most valuable manure. This will serve, in part, to show why the manure from the sty is so fertilizing. Swine are fed on a great variety of rich food. The actual profit of raising them arises mainly from the amount of substances they will mix together and make into good manure. If the sty be supplied, at intervals, with mud, loam, and other vegetable matter, the farmer will not complain of the cost of these animals.

Liquid manures are highly useful to grasses. Care should be taken to apply them, also, to the compost heap. The richness of manure from the sty is due to the quantity of liquid matter it contains. Hence the importance of adding a great variety of vegetable substances, loam, and mud. In a word, it may be said that all liquid manures contain a large amount of nitrogen, which is one principal ingredient of ammonia, to which we have alluded. The importance of saving the liquid

of the stable, either with the compost or to be applied by itself, may be seen, also, in the fact that the exceeding richness of guano, and the manure of all fowls and birds, is due to the union of the liquids and solids.

After fermentation has taken place in animal manures, in the compost or elsewhere, they may be spread without much loss by evaporation; and hence it matters not whether the top-dressing is applied in the autumn or in the spring. Plaster is better spread in the spring, when the moisture of the earth makes it immediately available. Some prefer the autumn for spreading compost manures, while others prefer the spring, just before the thick grass surrounds and protects them from the sun and wind. The soil, in autumn, is not injured by the loaded cart, as is liable to be the case in spring. Others, still, apply them after the first mowing, and before the summer rains. The new crop preserves the manure from drying up and wasting. This, however, is ordinarily too busy a season to attend to it with convenience.

We have, then, these several methods of improving our pasture lands. First, To allow some of them to run to wood, or, which is far better, to plant them with forest trees, which should never have been entirely cut from them. This applies to poor, thin soils, at a distance from the homestead, and chiefly in the older states, where the pastures have become exhausted or run out.

Second, To plough and cultivate, where this can be done, on strong, good soils, which are not too stubborn and rocky. This applies to many lands which have been used as pastures time out of mind, the soils of which are naturally good, but have run out from neglect. Put soil into a good state of culture, and rich and nutritive grasses will flourish as naturally as

weeds. The former are nearly as spontaneous on good soils as the latter are on poor ones. The success will depend chiefly on good culture, if this mode is adopted.

Third, To scarify the surface thoroughly with a sharp-tooth harrow, sowing on a suitable mixture of grass-seeds spoken of above, and then harrow and brush over again, the work to be done in September or very early in spring, if the surface is hard enough to go over with cattle without too much poaching. This applies to old pastures covered with moss, where the sweet grasses are run out, but which, from their particular location, may not be desirable for woodland, nor pay for a more complete and careful improvement.

Fourth, To mix the grass-seeds as evenly as possible with a finely-divided compost, and use it as a top-dressing, first harrowing the surface to loosen it, and, after spreading the compost, brushing it over with a brush harrow to break up the lumps. This will cost a little more than the preceding method, but the grass-seed will start sooner, make a larger and finer growth the first season, and give greater satisfaction. This applies to very much the same class of lands as the preceding. In both cases, if the pasture or any part of it is covered with bushes, they should of course be cut or grubbed up; if it is wet or covered with stagnant waters, they should of course be drained off, so as at least to leave a dry and healthy surface. It is unnecessary to say that the top-dressing should be free from weed-seed, and be in a finely divided state. This method of improvement is perfectly practicable on thousands of acres which are now in a state both discreditable and unprofitable to their owners.

Fifth, To pasture sheep, turning in as many as the pasture will carry, — stocking, in other words, pretty

closely, for a few years. The first objection that many farmers raise to this method is, that the cost of fences is great, and that it is a branch of husbandry with which they are not acquainted. This may be so, but the testimony of those who have tried this method is uniformly in its favor. I have had some experience and considerable observation in sheep husbandry, and my attention has been called to the changes wrought by sheep upon rough pastures covered with bushes and briers in part; and it appears to be a practicable method of improvement, while the raising of sheep and lambs for the shambles is destined to be a profitable branch of farming.

Another practicable means of improving our grass lands is by irrigation. Every casual observer, even, is familiar with the fact that lands are fertilized by irrigation, and especially that the grass by running streams shoots earlier in spring, and makes a far more thrifty growth, than lands on the same kind of soil which have not the advantage of running water. The introduction of the hydraulic ram among the implements of the farm offers facilities for irrigating grass lands not hitherto known; and it will unquestionably become, hereafter, an important means of guarding against our severe summer droughts, and of increasing vastly the production of our lands.

It would be impossible to state with any detail the different methods adopted to effect the objects of irrigation, since it would require a distinct treatise upon the subject; and it is sufficient to allude to the simplest mode employed with success, and the advantages offered.

Superficial irrigation, which is, perhaps, the oldest and the most common form in which water is artificially applied for the purpose of increasing the growth

of grass, was undoubtedly suggested by observing the wonderful effects arising from the overflow of rivers. Remarkable examples of this are familiar to many, as the annual or periodical overflowing of the Nile, where the water, without being left to stagnate upon the surface, is moving gently over it, depositing whatever alluvial matter it may hold in suspension. The extraordinary richness of the valley of the Mississippi, and on a smaller scale of the valleys of the Connecticut and other rivers, is mainly due, also, to this kind of irrigation; and this is imitated in our attempts to conduct water over grass land by a system of shallow, open drains, which take the water from its natural channel, keeping a constant flow, without allowing it to accumulate in any part.

The process of surface irrigation is not so simple as many would suppose. It requires considerable skill and practice, and many failures have followed experiments of this kind, made without due care and attention. Sir John Sinclair, however, in speaking of this operation, calls it one of the "easiest, cheapest, and most certain modes of improving poor land, in particular if it is of a dry and gravelly nature. Land, when once improved by irrigation, is put into a state of perpetual fertility, without any occasion for manure, or trouble of weeding, or any other material expense; it becomes so productive as to yield the largest bulk of hay, besides abundance of the very best support for ewes and lambs in the spring, and for cows and other cattle in the autumn of every year. In favorable situations, it produces very early grass in the spring, when it is doubly valuable; and not only is the land thus rendered fertile without any occasion for manure, but it produces food for animals which is converted into manure to be used on other lands, thus augmenting that great source of fertility."

The effect and value of irrigation do not depend

altogether upon the artificial supply of moisture which it furnishes to the plant. "The mechanical action of the irrigatory current of water, in exercising the plants, strengthening their organisms, keeping their stems and root crowns clear of obstruction, promoting the equable circulation of water and oxygen around them, and causing an equable distribution of the soluble materials of their food, probably plays a considerable part in irrigatory fertilization. The differences of effect, from the mere circumstance of flowing or stagnation of the water, are prodigious; for, while flowing water coaxes up the finest indigenous grasses of the climate, and renders them sweet, and wholesome, and nutritious, and luxuriant, stagnant water starves, deteriorates, or kills, all the good grasses."

The effect which surface irrigation produces on the nutritive qualities of the grasses may be seen by reference to the tables of analyses found in a preceding chapter.

But, if one thing more than another may be said to lie at the foundation of all real improvement of grass lands, or lands under a course of rotation, it is a proper system of drainage. Especially is this important for low, wet lands, since it not only frees them from superfluous water, thus making them more susceptible of tillage in early spring, but actually increases their temperature several degrees, — in some cases as much as from eight to ten, and rarely less than from two to four, — and admits the air to circulate more freely around the roots of the plants. The aquatic grasses require large and constant supplies of moisture, and when the soil is changed by drainage the more valuable species of grass may be introduced and cultivated in it.

With regard to the management of salt marshes, though they cannot be under-drained, there are few

which cannot be ditched, and greatly improved, by the introduction of a better quality of grasses than those usually found there. The following statement of one of the most intelligent practical farmers of the country will show what may be done in this direction:

The marsh was one which never had been ditched. "I purchased it," says he, "in 1840, which year it produced rather less than half a ton per acre of poor, short, wiry hay, worth but little more than the cost of cutting and curing. In the autumn of that year, I hired faithful laborers, well skilled in the business, to cut ditches over the whole lot, two rods apart, eight inches wide and three feet deep; the sods taken out were laid in piles, to prevent the tide from washing them away. The two following winters, they were taken upon a sled to the cattle-yard, where they remained until the roots of grass contained in them were decayed, so as to break in pieces readily. For manure, and as an absorbent, they are as valuable as the best of meadow muck or peat. I paid for ditching the entire lot ninety dollars; more than one hundred cords of sods were dug out and carted away, which I consider worth as much to me as the sum paid for ditching. They were placed in the barn-yard, in a compact form, to insure a proper degree of moisture and cause a speedy decomposition, and afterwards mixed with animal manures.

"Three years after ditching, the produce was double, — full one ton per acre was cut, of an improved quality, — since which it has annually increased. This year the produce, as estimated by good judges, was two tons per acre, including about five tons of second crop, cut from the best part of the marsh. As an evidence of the quantity cut this year, I would state that the produce has been sold for three hundred dollars in cash,

after the owner had used nearly one ton for feed for his cows, the purchaser agreeing to take it at the barn where it is now stored.

"I consider salt hay, when cut from marshes that have been ditched, *where the grass is thick and the yield large*, to be worth as much as the average of upland hay; that cows thrive as well, and give as much milk, as when fed with Timothy grass and clover hay. It is my belief that all marshes can be made more productive by thorough draining, at a very small expense. I intend, next autumn, to cut ditches upon my own marsh between those heretofore made. My opinion is unchanged, that the sods are worth as much as the expense of ditching, when within one mile of the farm where they are to be used."

This subject ought to receive the careful attention of the enterprising farmer. Even a farmer of very limited means may do something each year towards improving his pasture lands. He may lessen the area of the bushes; he may plough up a small piece, at least, and seed down at once with grass-seed and winter rye, either in the spring or in the fall, and in either case his stock will fare enough better to pay for it; and the next year he may take another piece in the same pasture, till the whole is finished, when it will carry more stock, and more stock will give him more manure, and more manure will increase the fertility of other lands, and increased fertility will add to his means of further improvement. The difficulty with most small farmers is to begin. Well begun is half well done; for, the moment any real improvement is begun in earnest, the interest is excited, the mental activity is increased, the desire for improvement partakes the nature of a passion; and hence, though the begin-

ning may be small, the ending may be the renovation of the owner as well as the land.

CONCLUSION.

In conclusion, I have another suggestion to make, as to the propriety of encouraging the collection of grasses for exhibition at the anniversary festivals of our agricultural societies. It would be an easy thing, I think, to engage many in this fascinating pursuit. Some, undoubtedly, would be interested by the simple suggestion, but the offer of small premiums for the largest and best-arranged collection would induce others to attempt it who now want something to stimulate them to the work. The premium, however small, might afford the necessary stimulus; and, if an interest were once excited, the subject would be still further pursued, till many others were interested, while the collections, if properly named, would do much to disseminate a higher knowledge of the exhaustless riches of this class of plants.

> "The royal rose, the tulip's glow,
> The jasmine's gold, are fair to see;
> But while the graceful grasses grow,
> O, gather them for me!
>
> "The pansy's gold and purple wing,
> The snow-drop's smile, may light the lea;
> But while the fragrant grasses spring,
> My wreath of them shall be!"

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